In this Issue
AIRCRAFT PRODUCTION MIRACLE OF 1942

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AVIATION

January, 1943

Volume 42 • Number 1

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In This Issue

The American air transportation system is and has been the most highly developed system of its kind in the world. When this nation took up arms against the Axis, the Army and Navy Departments found at their immediate disposal an invaluable war weapon, which had been forged and made to run smoothly through the efforts of private enterprise. In a sharply focussed editorial, the editor points out that the presently evident trend toward militarization of air transport operations "accomplishes nothing that could not be better accomplished without it" ..... **Page 89**

The war production miracle of 1942 accomplished by the aviation industry is summarized, accompanied by statements concerning the contributions of individual companies **Page 92**

Keeping airports open for traffic the year around is a vital wartime necessity. A complete description of ways and means of handling snow on airports appears on ..... **Page 98**

Good tooling is largely responsible for Boeing's fantastic production rate. How correct tooling has increased the rate of production and made possible the successful utilization of unskilled labor at Boeing is described, beginning on ..... **Page 106**

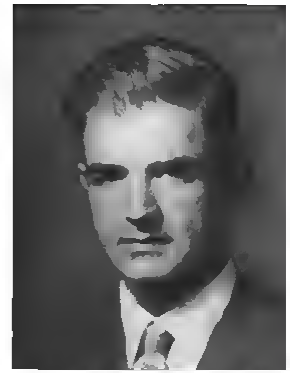
Minimum landing and takeoff runs have always been an important factor in flying technique. In a study of key factors, the pilot is given a new technique to shorten his ground runs when necessary ..... **Page 94**

Perspective drawings are an important tool on aircraft assembly lines. Execution of these drawings on a mass scale is largely a matter of training artist personnel. To aid in this training work, the first in a series of articles outlining the fundamentals of drawing technique appears on **Page 118**

Proper application of Plexiglas depends largely on the material's strength properties. A detailed analysis of these properties are provided for the designer in a series of two articles. The first covers basic impact-strength factors and appears on ..... **Page 128**

The Madsen method of forming lines is a significant advance in the art of lofting. Based on graphical calculus, the method vastly simplifies a difficult lofting detail and provides heretofore unattainable accuracy..... **Page 138**





Chris J. Frey (left), of Brewster Aeronautical Corp and **Stanley S. Kagel** (right), whose series of articles on drop hammer operations and methods are concluded in this issue with "More from Your Drop Hammers", on page 143

The drop hammer operations series is concluded in this issue with a discussion of efficient hammer set-ups, and further information on fabrication of dies ..... **Page 143**

Design information for plywood structures is continued with a discussion of basic stress analysis..... **Page 150**

Maintenance of aircraft and engine parts is vastly simplified and improved by metallizing. A complete description of this process and its application appears in the Maintenance Section..... **Page 231**

With air cargo one of the important topics of the day because of its post-war implications, a discussion of the economic and regulatory factors that will combine to establish a national policy is especially timely. **Page 255**

Also included in this issue is an illuminating description of the tactical uses of the Lockheed Lightning (page 101), an article on the investment status of the aviation industry (page 96), a timely discussion of the activities of certain scientific groups on the use of rocket power for assisted takeoff (page 100); and a summary of legal requirements for labor standards in the aviation industry including subcontractors (page 127).

In the Factory Maintenance section is a discussion of how to get the most wear out of your battery-operated plant truck (page 155). To be found in other departments is a technical description of flight strips which are appearing all over the country these days (page 247), a description of visual training of mechanics (page 269), and other regular Aviation features such as the Sketch Book of Design Detail (page 167), Engineering Data Book (page 173), and the Maintenance Notebook (page 230)

Coming

The February issue is the Tenth Annual Edition of AVIATION's Yearbook, containing the most authentic compilation of facts and figures on planes, engines, equipment, plants and personnel. There will be about 300 photographs and silhouettes of American, British, Russian, German, Japanese and Italian airplanes. Also the most up-to-date available specifications on these airplanes and their engines.

The newly arranged buyer's guide and listing of the aviation industry's personnel will be invaluable to everyone doing any kind of business with the aviation industry.

Plan for a Long War— Work for a Short One!

No one can say how long this war will last. But maintenance can say how long America's *motors* will last... and how efficiently they will work to help *shorten* the war!



MAINTENANCE "as usual" went out with Pearl Harbor. Today, every U. S. maintenance man knows he's pitted against a Jap or Nazi maintenance man. He's got a man-sized job...



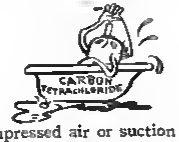
For example, if the current in a motor exceeds its nameplate current rating, heating may increase as much as the *square* of the current increase! And when a motor runs a fever, there's trouble ahead...



Excessive heat can "fry" the life out of insulation, melt soldered connections, burn out bearings. That's why a close eye must be kept on every motor's overload protection.



Friction is another dangerous source of heat — so the right lubricant in the right amount must be kept *in* bearings and dust must be kept *out!* For cool-running motors, dust must be kept out of *windings*, too...



If compressed air or suction doesn't get the dust out, it's necessary to give the dirty motor a "bath". *Promptly*, too — because the rim travel of a rotor in many motors today is round the world *every eight days*...



Some job to keep motors rolling at that rate — for the duration!



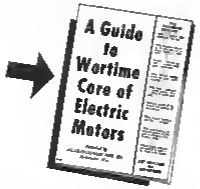
Just as "rutting" is fought in road maintenance, "grooving" must be fought in *motor* maintenance. Some wear is inevitable on slip rings and commutators, of course. But *smooth and even* wear is *slow* wear!



"Keep oil where it belongs" is a basic rule in maintenance. Once outside bearings, it attacks any insulation it reaches. *Inside* bearings, oil must be protected against misalignment pressures...



The oil film guarding a bearing often is no thicker than the wall of a soap bubble . . can fail just as suddenly — *and completely!*



For the full story of what *today's* maintenance should be, send for your free copy of "A Guide to Wartime Care of Electric Motors." It's fully illustrated (with the sketches above and many more), practical, complete. ALLIS-CHALMERS MFG. CO., MILWAUKEE, WISCONSIN.

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FREE BOOKLET ON HOW TO FLY. Send today for your copy of the easy-to-understand booklet "You, Too, Can Fly!" If you also want the full-color Piper catalog, enclose 10c in stamps or coin for postage-handling. Piper Aircraft Corporation, Department A13, Lock Haven, Pennsylvania, U.S.A.

PIPER POINTS THE WAY TO WINGS FOR ALL AMERICA

TRAINING! *the most important thing . . . . .* FIRST

Today's rush production schedules and maintenance of the tremendous number of planes demanded by President Roosevelt has brought out the vital fact: TRAINING is the most important thing FIRST. As a result this has brought about the employment and enlistment by the armed forces of thousands of men who can meet the minimum requirements by short "quickie courses." BUT only men with MAXIMUM training can hope to win advancement to responsible and well paid positions either in civil or military aviation. BE FAR SIGHTED . . . the future holds more than war with the inevitable readjustment to post war conditions. The Aviation Industry cannot hope to retain all the number of workers demanded by the present emergency. When the war is over as it eventually must be, the only way you can assure yourself of a career and occupy a vital supervisory position with the assurance of a future in aviation, is to train NOW.

The executives who have made aviation their career know the value of each man is governed by two factors, his intelligent sincerity in selecting aviation as his life's work, and THE ABILITY AND EXPERIENCE OF THOSE WHO TRAIN HIM FOR THAT CAREER. They know that Curtiss Wright Technical Institute graduates are . . . and for many years have been . . . thoroughly qualified to fill the industry's requirements.

Located in the very center and a very important part of Southern California's great aircraft industry, with its more than two billion dollars in unfilled orders, Curtiss Wright Tec has come to be recognized as the nation's leading institution for the training of Aeronautical Engineers and Master Aviation Mechanics. Mr. Donald Douglas, President of the great Douglas Aircraft Company chose this school for his own son's training, which pointedly indicates the high standing Curtiss Wright Tec has attained in the aircraft industry since its establishment in 1929.

It is imperative that before you invest in a course of career training you determine what the returns will be on your investment . . . for your choice of a school in which to take your training will determine how much money you will make all the rest of your life.

Curtiss-Wright Tec's career training is carefully designed to do just one thing—TO MAKE MONEY FOR YOU as upon graduation you can be independent and self-supporting for life. Our thousands of successful graduates have proven that Curtiss-Wright Tec training gets results and always pays since it trained them in advance for the highest position they could ever expect to occupy. It can do the same for you.

This school has never guaranteed positions for its graduates but practically every graduate has obtained immediate employment and is advancing rapidly. The demand for our graduates far exceeds the supply, and we honestly believe that every student who enrolls here will be able to obtain, with our assistance, immediate employment upon graduation.

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"I will"

The following was found on the flyleaf of the diary of an Iowa boy who fell at Chateau-Thierry in 1918:

"America *must* win this war. Therefore *I will* work; *I will* save; *I will* sacrifice; *I will* endure; *I will* fight cheerfully and do my utmost, *as if the issue of the whole struggle depended on me alone.*"

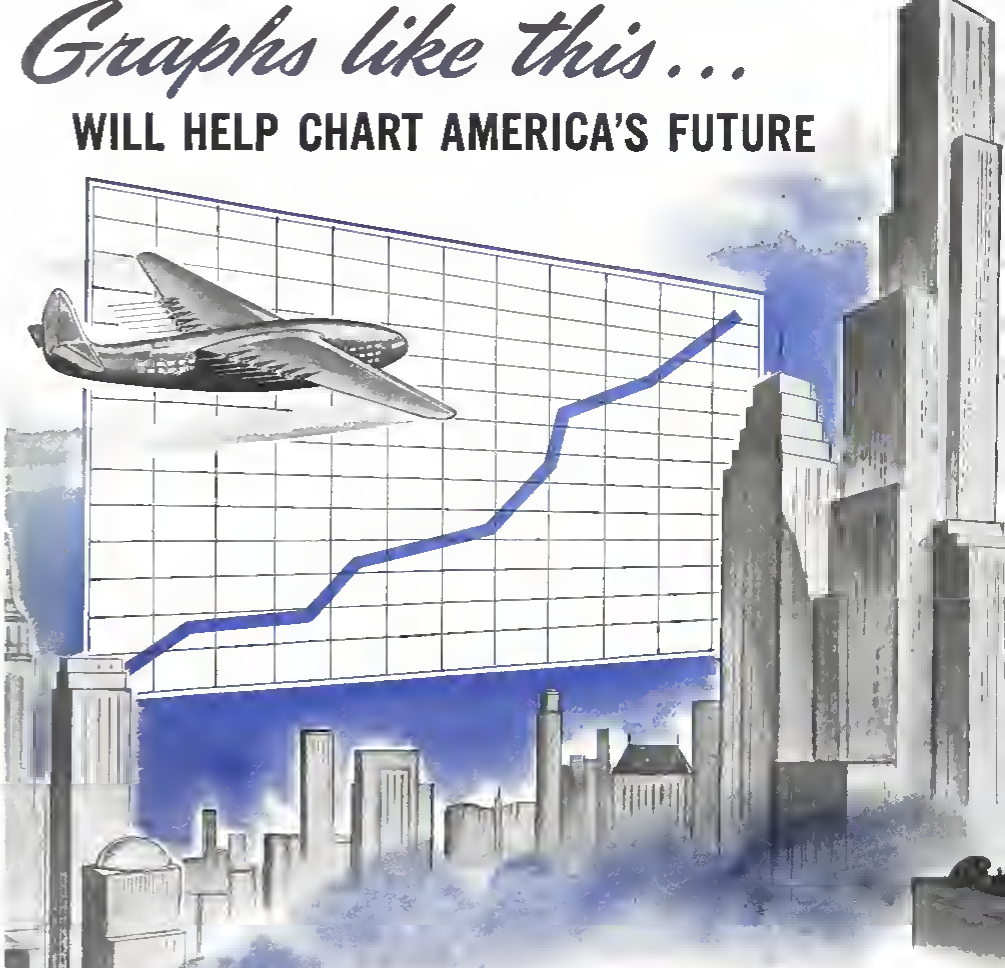
..."as if the issue of the whole struggle depended on me alone."

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Graphs like this...

WILL HELP CHART AMERICA'S FUTURE



Behind such graphs as this lies a story. A story of men and machines... of planning and working that never stops... of meeting and beating production schedules. For on America's War Production depends the future of America—and the World.

Nowhere is that truer than in the aircraft industry. Production quotas have been doubled and redoubled—and increased again. Deliveries of planes by the hundreds have become thousands—and many more thousands are needed.

That's why at McDonnell, we're proud to present this chart. What we make and how much—well, that's a military secret. But it's no secret that our deliveries of aircraft and parts for the Armed Forces have increased many fold as the chart indicates—since December seventh—and we were working three shifts even then.

At present, our entire resources—men, material, machines, research facilities, engineering and designing ability and experience—all are dedicated to one primary objective—to produce the best possible planes and equipment in the least possible time. For the future depends on the present—and our present job is to *deliver the goods.*

McDONNELL AIRCRAFT CORPORATION

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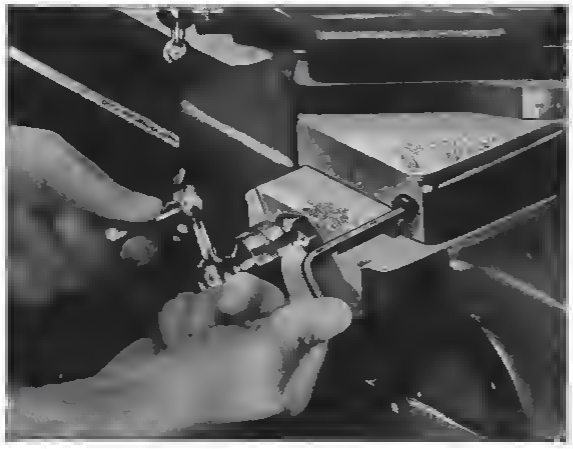
HOW TO GET THE MOST OUT OF YOUR LATHES

No. 4 in a series of suggestions made by the South Bend Lathe Works in the interest of more efficient war production

Keep Your Lathes in Trim

The old proverb, "An ounce of prevention is worth a pound of cure", is as applicable today as when first expressed by some long forgotten sage. Lathes and other modern precision tools must be "kept in trim" if they are to give the long, trouble-free service that is expected of them

Although the adjustments required to "keep the lathe in trim" are few and simple, they are important and should not be neglected. And even though the lathe is rigidly constructed and will stand some rough handling, it should be protected from unnecessary abuse.



Adjust the dovetail gibs to insure accurate work

Power Transmission

Maximum efficiency as well as maximum production depends on the effective transmission of power to the lathe spindle The motor, being the source of power for the lathe, should develop its full rated power and should operate at a uniform speed. If for any reason the line voltage drops below the rating for which the motor is constructed, the motor will not deliver full power. For this reason the current should be checked at the motor occasionally and the correct line voltage maintained

To transmit the power from the motor to the lathe spindle efficiently, all belts must be properly adjusted If the belts are too loose they will slip, and if they are too tight they will cause loss of power through friction. The belts should be just tight enough to transmit the required power without slipping. Precision belt tension adjustments provided on South Bend Lathes make it easy to keep the motor V-belts and flat cone pulley belts properly adjusted.

Dovetail Slide

All dovetail slides on South Bend Lathes are equipped with gibs which may be adjusted to eliminate play. When the adjustment of the dovetail gibs is neglected, looseness of the slides may cause the tool to chatter or may result in inaccurate work

The gibs should be tight enough to assure the necessary rigidity, but not tight enough to bind and make the dovetail slides hard to operate.

Tailstock Adjustment

The alignment of the tailstock top should be checked frequently as any misalignment will cause the lathe to turn a taper. To test alignment, place a bar of steel, 1 inch or larger in diameter, between centers and machine two collars of equal diameter not less than 4 inches apart. Then, take a very light finishing cut across both collars without changing the setting of the cutter bit. Measure both collars with a micrometer. Any difference in the diameters indicates misalignment. Correct the alignment by turning the tailstock top set-over screws until both collars can be turned to the same diameter.

Don't Abuse the Lathe

Just because the lathe is made of iron and steel is no reason to expect it to stand abuse. Never use the lathe bed as an anvil. Don't use a crowbar to straighten a shaft between the lathe centers. Never rap chips out of a file by striking it on the lathe bed or tailstock.

Write for Bulletin H4

Bulletin H4 giving more detailed information on keeping the lathe in trim will be supplied on request. Also reprints of this and other* advertisements and bulletins in this series. State quantity wanted

*H1, "Keep Your Lathe Clean"
H2, "Oiling the Lathe"
H3, "Installation and Leveling of the Lathe"

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4900 Bloomingdale Road Chicago

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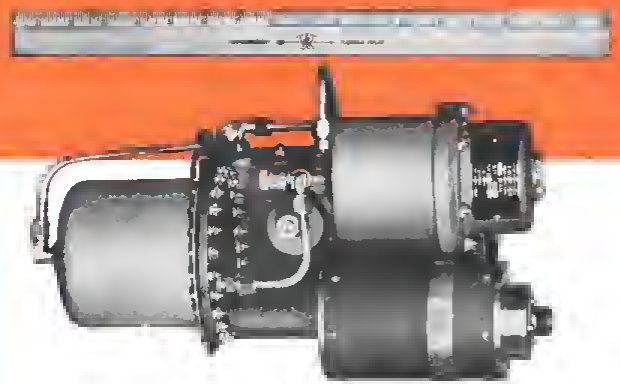
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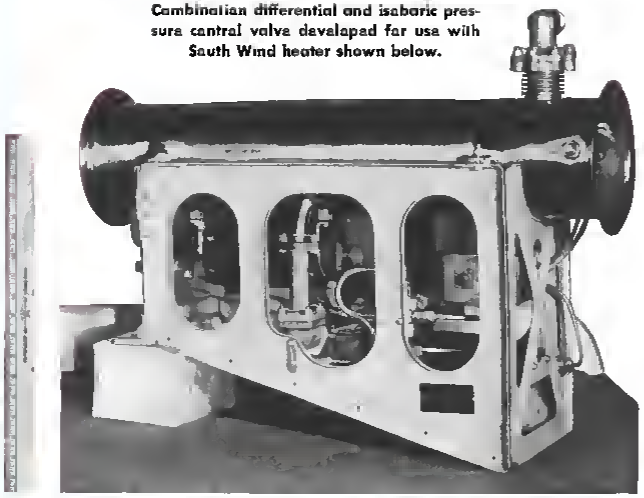


IT TAKES MORE THAN BTU'S

To Heat a Plane!



Combination differential and isobaric pressure control valve developed for use with South Wind heater shown below.



Submitted to Office of Censorship, which found no objection.

THE AVERAGE earth-bound heating expert tackling airplane heating finds himself in an utterly strange world. It's as though he were asked to install a furnace in a Florida home—and guarantee satisfaction if that home should be moved to the top of Mt. Shasta in February.

Through years of close cooperation with aviation engineers, South Wind heating specialists have learned the special problems in this heating field. Like you, they know that Btu's alone don't solve these problems—that heat, ventilation and controls are all essential ingredients in a proper solution.

Typical of many pioneering contributions made by Stewart-Warner South Wind engineers is the ingenious control mechanism shown on the opposite page. It was developed to operate the new South Wind heater shown with it, by tapping the plane's ventilating air supply.

From take-off to a given altitude, this valve maintains differential pressure. Beyond this point, pressure is held constant by isobaric controls.

The aviation industry has come to expect such advanced developments from South Wind engineers. And our long experience in aircraft heating—plus engineering facilities unrivaled in this field—plus world-wide field experience—heve enabled us to meet unusual requirements with speed and sound engineering. Let us tackle your heat problems.

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SKY TRUCKERS



The Sky Truckers are the cargo-plane pilots of the Navy's Air Transport Service and the Army Air Transport Command.

Their truck routes are a network of secret military airways more extensive than all the combined pre-war airways in the world. Some of the Truckers average more travel in a week than Columbus crammed into his lifetime. They fly complete hospitals to Alaska, tank parts to Africa, personnel to England—and even around the world!

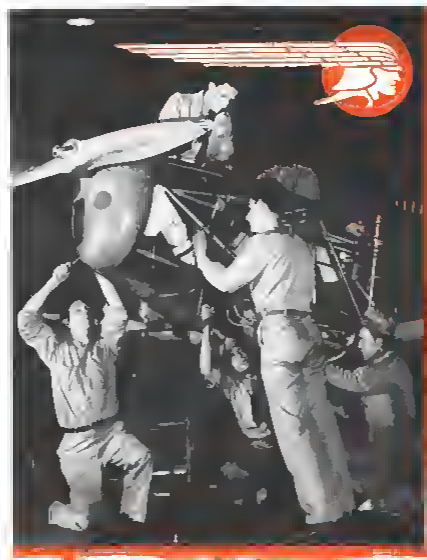
They tell us that the Consolidated C-87 is one of their favorite sky trucks because even with boxcar loads the big planes are swift, maneuverable, and easy to handle. And they say the C-87's operate as sweetly in the icy air over Alaska, where oil turns hard as rubber, as they do in gritty Cairo or steaming New Guinea.

* * *

At Consolidated's Fort Worth, Texas, plant, we're trying to do our job as splendidly as the Sky Truckers are doing theirs. We're rolling the C-87's down our assembly lines, twenty-four hours a day. We're rolling them fast, and we're rolling them good!

CONSOLIDATED builds Battleships of the Air

LIBERATOR . . . CATALINA . . . CORONADO . . . ALSO C-87's—FREIGHTERS OF THE AIR



SPARTAN

—keeps its great fleets of trainers flying with the aid of Snap-on Tools

EXPERTLY schooling an army of civilians in practically every phase of aviation . . . training United States Air Force Mechanics as well as flyers for the Army and for the Royal Air Force . . . Spartan School of Aeronautics at Tulsa, Oklahoma, places strong emphasis on *maintenance*. Keeping planes in perfect condition is a night-and-day operation with Spartan.

Snap-on tools are in widespread use in Spartan activities. Says George Hudson, Ground School Director, "I have personally used Snap-on tools for the last ten years on various jobs in the aviation industry. I have found them to possess the qualities necessary to get the job done, even under the most adverse conditions."

In every branch of aviation . . . from training schools to jungle flying fields . . . Snap-on tools have demonstrated their exceptional fitness for aviation's needs. Snap-on's 3,000 tools and direct-to-you service are conveniently near you from 35 factory branches at key aviation centers throughout the United States and Canada. Write for catalog and full information.

Snap-on Tools
THE CHOICE OF BETTER MECHANICS

SNAP-ON TOOLS CORPORATION
8020-A 28th Avenue Kenosha, Wis.

10% INVESTING FOR VICTORY! The employees of Snap-on Tools Corporation are enrolled in the Treasury's 10% payroll deduction plan.



A Klixon Circuit Breaker Can Save It

The miles of electrical circuits, which make up the nerve system of a plane, are frequently endangered by shorts or overloads. But this danger can be quickly eliminated if the plane is equipped with Klixon Circuit Breakers or Protectors. Harmless momentary overloads are carried without tripping, but if a short circuit or a sustained overload endangers the plane, these devices will promptly trip-out, thereby protecting the circuit. And once the overload condition is corrected, the pilot can reestablish the circuit by merely pushing a button or turning a switch. No fuses have to be changed. No trouble is involved. Everything is done by finger-tip control right on the instrument panel board.

Get the complete information on these lightweight, shock-proof, vibration-proof and ambient-proof circuit protective devices. Send for bulletins showing dimensions, ratings, and performance characteristics.

CIRCUIT PROTECTORS

Klixon PM (NAF-4131) Circuit Protector—Push Button Type. Ratings through 40 amperes in close convenient steps.

Klixon PSM Circuit Protector has same mounting dimensions as Standard AN Toggle Switch. Ratings through 35 amperes.

Other Klixon Circuit Protectors—push button type —available in ratings up through 250 amperes

CIRCUIT BREAKERS



Klixon C-6363 Switch Type Circuit Breaker. Small compact. Ratings through 30 amperes in close convenient steps.



Klixon D-6364 Switch Type Heavy Duty Circuit Breaker. Ratings from 35 through 120 amperes in close convenient steps.

KLIXON

SPENCER THERMOSTAT COMPANY • ATTLEBORO, MASSACHUSETTS

IT WILL BE A "FIGHTING FIRST" AT SPARTAN ...This Year



The curtain of time is fast drawing across the close of another year. The past with its accomplishments and failures recede in favor of a future of new hopes and new determination. As 1943 dawns upon a world of human turmoil, let us gather new strength from the comforting influence that a free America continues to stand as the staunch leader upon which other nations look as the unconquerable defender of the Democratic way of life.

SPARTAN accepts the challenge this new year brings . . . to meet all bravely and with that fine spirit that abides in American hearts . . . a spirit that will bring victory to a just and righteous cause. This will be a "fighting first" at SPARTAN. Every man will face the job with new resoluteness. Every machine will roar out its defiance. And every day thereafter, the SPARTAN production line will continue to produce vital war materials until victory is attained.



SPANTON SCHOOL OF AERONAUTICS

This "University of Aviation," operated as a division of the Spartan Aircraft Company, also faces the new year with renewed determination to continue to train young men for successful careers in aviation . . . to continue to aid in supplying the skilled manpower so vitally needed by the aviation industry . . . to continue to give young Americans the background that will equip them for leadership in the great peace-time commercial aviation era that will follow the war.

SPARTAN
AIRCRAFT COMPANY

TULSA, OKLAHOMA

Contractor to the U. S. Army and the U. S. Navy

BUILDERS OF FINE AIRCRAFT SINCE 1929

Train to Fill a Vital Need



America needs pilots, thousands of them, to serve in essential positions on the home front and on the battle front! She needs instructors to teach Uncle Sam's "fledglings" . . . commercial pilots to fly the nation's airlines . . . pilots to man the giant cargo planes assigned to the Air Transport Command . . . pilots to deliver America's fastest and most powerful planes to our Allies. These and many other highly paid positions are begging for trained fliers—and SPARTAN School is ready to make you one of the best.

The civilian flying school at SPARTAN is one of the largest in the nation and is playing an important part in America's pilot training program through all types of flight courses, including: (1) Commercial and Airline Pilot courses; (2) Link-Instrument training course; (3) Flight Instructor course; (4) Special Refresher Flying courses

SPARTAN offers you all these advantages: A fleet of 28 modern training planes, valued at approximately $200,000—skilled instructors—a location in the heart of the nation's finest flying country—seven flight fields—light, airy classrooms — 29 modern buildings located on 50 acres — fully equipped shops and laboratories. SPARTAN is Government approved and top-rated in the industry.

A Life-time Career—War-time developments in aviation are setting the stage for a gigantic new peace-time era in air transportation and commerce that will offer spectacular opportunities for fliers who are ready. Act now to serve your country in an important position . . . to enjoy a fascinating lifetime career in commercial aviation after victory. *New semesters start January 4 and March 15.*

SPARTAN SCHOOL OF AERONAUTICS
DIVISION OF SPARTAN AIRCRAFT COMPANY

Spartan School of Aeronautics—Captain Maxwell W. Balfour, Director
Address Dept. A13, Tulsa, Oklahoma

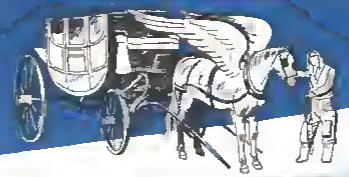
Check Courses You Prefer

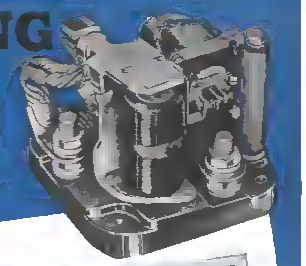
Send me your new Catalog describing in detail the SPARTAN courses I have checked, also stating tuition and living expenses.

- ☐ Commercial Pilot
- ☐ Airline Pilot
- ☐ Commercial Flight Instructor
- ☐ Aeronautical Engineering
- ☐ Airline Maintenance Engineering
- ☐ Aircraft or Engine Mechanic
- ☐ Aircraft Sheet Metal
- ☐ Aircraft Assembly Mechanic
- ☐ Airline Service (A&E) Mechanic
- ☐ Airline Communications
- ☐ Private Pilot Course
- ☐ Weather Forecasting
- ☐ Instrument Technician
- ☐ Women's Instrument Technician

Name ..... Age .....
Address .....
City ..... State .....
Previous Flight at .....

HOSTLER for FLYING HORSEPOWER





JUST AS HOSTLERS USED TO CHANGE STAGE-COACH HORSES, AIRPLANES CHANGE FROM ONE SOURCE OF ELECTRICAL HORSEPOWER TO ANOTHER . . . BEFORE THE PLANE'S ENGINES ARE "REVVED UP", ELECTRICITY IS SUPPLIED BY BATTERY . . . AS SOON AS THE GENERATOR IS TURNING FAST ENOUGH TO PRODUCE SUFFICIENT CURRENT, A SMALL WESTINGHOUSE RELAY SWITCH AUTOMATICALLY CONNECTS THE GENERATOR TO THE LOAD . . . ALTHOUGH UNUSUALLY SENSITIVE, THE LITTLE SWITCH STAYS ACCURATE IN SPITE OF EXTREMES IN WEATHER, TEMPERATURE AND VIBRATION . . . WHETHER MOUNTED VERTICALLY OR HORIZONTALLY, IT IS DESIGNED TO OPERATE WITH ANY 28.5 VOLT, DIRECT-CURRENT GENERATOR UP TO 200 AMPERES AND WILL GIVE THE SAME RELIABLE PERFORMANCE AS THE DYNAMOTORS, GENERATORS AND AUXILIARY MOTORS PRODUCED FOR AIRCRAFT BY THE WESTINGHOUSE SMALL MOTOR DIVISION.

J-031/9

Westinghouse
SMALL MOTOR DIVISION

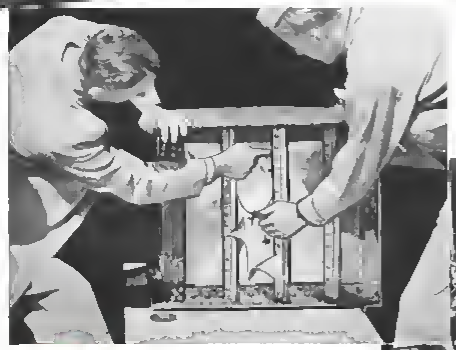
These Martin Firsts help make

U. S. AIRCRAFT

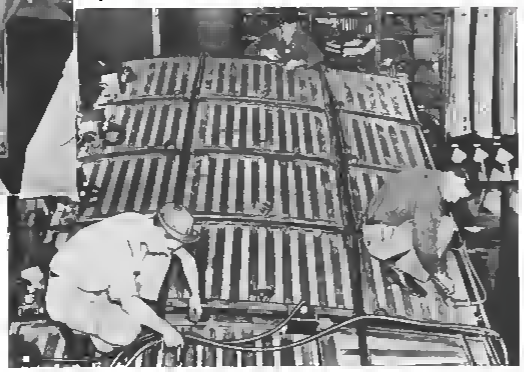
SECOND TO NONE!



FIRST all-plastic aircraft nose, used on the Martin B-26, giving bombardier full visibility and absorbing recoil of forward gun. Martin was working on plastic noses and other parts as far back as 1921. Today some Martin types contain 400 plastic parts.



FIRST to develop "heat therapy" for airplane wings. A giant heating "pad" is applied to aluminum covering of wing, expanding this "skin." Riveted when hot, skin shrinks when cool, fits tightly over spars without wrinkling or buckling.



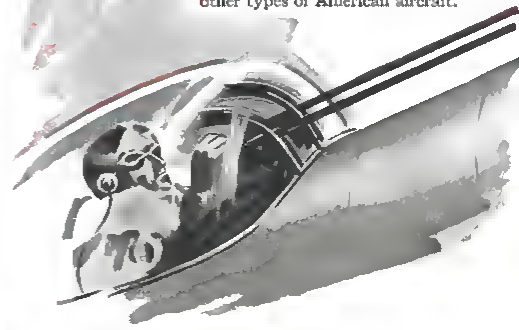
FIRST U. S. self-sealing fuel tank. Martin Mareng tanks are now standard equipment on many American aircraft. Martin experiments on self-sealing fuel tanks date from 1919, during which period more than 285 different materials were tested.



FIRST to develop photo-layout method, utilizing giant camera. Through this method, scale photos are reproduced directly on sheet metal, eliminating layout time and speeding production. In addition, drawings may be scaled up or down swiftly, accurately.



FIRST U.S power-operated gun turrets, giving our bombers strong protection against enemy interceptors. Martin is manufacturing power-driven turrets not only for Martin bombers but also for many other types of American aircraft.



Martin
AIRCRAFT
Builders of Dependable Aircraft Since 1909

These are only a few Martin "firsts." Some are still close-guarded military developments, while numerous others, individually minor but collectively important, are in use throughout the aviation industry to give America better planes and more of them. But Martin engineers are never satisfied. In scores of diverse fields, work goes on to give America even mightier planes for today's aerial fights, tomorrow's peacetime flights.





It's Self-locking

The Boots principle of self locking nut as employed in the Bellows, Wing, and Rol-Top (illustrated above) styles is well-known throughout the aircraft industry. In each case the nut is one-piece, all metal. The self locking action is obtained by means of the out-of-phase locking collar connected to the load threads by means of a resilient spring member

Here are a few of the planes fabricated with Boots Nuts:

Grumman Wildcat F4F-3
Boeing Flying Fortress B 17E
North American B 25
Curtiss Commando C-46
Consolidated Liberator B 24E
Curtiss P-40
Curtiss Dive Bomber SB2C-1
Brewster Buccaneer
Edo Floats
All Plywood Planes

BOOTS FOR THE PLANES OF CHINA

On the landing fields of China, even the coolie boy pitches in to help the maintenance men . . . and so he, too, knows about Boots for the planes of China.

If you could ask the men who repair the planes or the pilots who fly them, not only in China but wherever American fighter planes fly, you'd find out *why* Boots Nuts have earned such an enviable reputation. You'd learn that they are generally lighter in weight, have greater re-usability in maintenance and are proof against any airplane vibration. They literally "outlast the plane." There is lasting economy in the use of Boots Aircraft Nuts. And, of course, they meet the exacting specifications of all Government agencies.

For the engine manufacturer, Boots "Rol-Top" Nuts excel in performance under higher temperatures.

BOOTS

Self-Locking Nuts For Application In All Industries

BOOTS AIRCRAFT NUT CORPORATION ★ GENERAL OFFICES, NEW CANAAN CONNECTICUT

Service Tested THRUOUT THE GLOBE



On every fighting front in this global war you'll find ADEL aircraft equipment serving the United Nations' Air Forces, our first arm of both defense and *offense*. 5 ADEL manufactures 3,000 sizes and types of line support, anti-icing, hydraulic and allied equipment—standardized, precision built units which are made to stand the gaff regardless of temperature, altitude, vibration or the stress of combat service. In the service of U. S. Air Forces, British Air Ministry, R. A. F., R. C. A. F., R. A. A. F., Soviet and Chinese Air Forces, ADEL workmen are developing new skills and precision techniques which after Victory will serve mankind in many constructive ways

ADEL

PRECISION PRODUCTS CORP.

BURBANK, CALIFORNIA

Engineering Service Offices: DALLAS, TEXAS • DETROIT, MICHIGAN • HUNTINGTON WEST VIRGINIA • HAGERSTOWN, MARYLAND • TORONTO, CANADA

FEDERAL

Aircraft

BEARINGS

EVERY FEDERAL AIRCRAFT BEARING IS CAREFULLY MANUFACTURED AND PERFECTLY FINISHED • PRECISION AND ACCURACY DOWN TO THE SMALLEST DETAIL. FEDERALS ARE TOUGH. STRONG. DURABLE —AN INVESTMENT IN BALL BEARING SERVICE AND SATISFACTION •



THE FEDERAL BEARINGS CO. INC.

Makers of Fine Ball Bearings

U. S. A.

REPRESENTATIVES LOCATED AT

Detroit: 2640 Book Tower • Cleveland: 402 Swetland Building

Chicago 302 S. Wabash Ave • Los Angeles: 5410 Wilshire Blvd.

You can cut installation tim

almost 50%

WITH G-E COMBINATION STARTERS

Regularly furnished for use with motors up to 200 hp



MOUNTING TIME CUT 50%

You avoid one complete mounting job on every installation when you use combinations—because combination starters combine both a motor switch and a magnetic starter in one compact unit.

WIRING TIME CUT 40%

Users report that they're cutting wiring time as much as 40 per cent with G-E combination starters. That's because these combinations come to you already wired. Just connect the power and motor leads and you're ready to go.

COMPLETE PROTECTION FOR EQUIPMENT AND PERSONNEL

Fuses and overload relays are co-ordinated to provide complete protection for your operating equipment. A special safety interlock—case cover can't be opened while power is ON, and power can't be thrown ON while cover is open—provides extra protection for your operators and maintenance men.

But these aren't the *only* advantages of G-E combinations. Their compact construction saves you valuable plant space. This same compactness can help you speed production—you mount the whole control close to the operator's work. Call our local office today to find out what G-E combination starters can do on your job. *General Electric, Schenectady, N. Y.*

A combination starter is a manual circuit switch plus a magnetic starter.

Navy "E" for Excellence has been awarded to 92,700 General Electric employees in six plants manufacturing naval equipment

GENERAL ELECTRIC



Out of the air over land and sea will come Victory. Better trained pilots, better built and better equipped airplanes will blast open the roads to decisive invasion. Howard Aircraft will continue to help by building better planes for training.

Howard

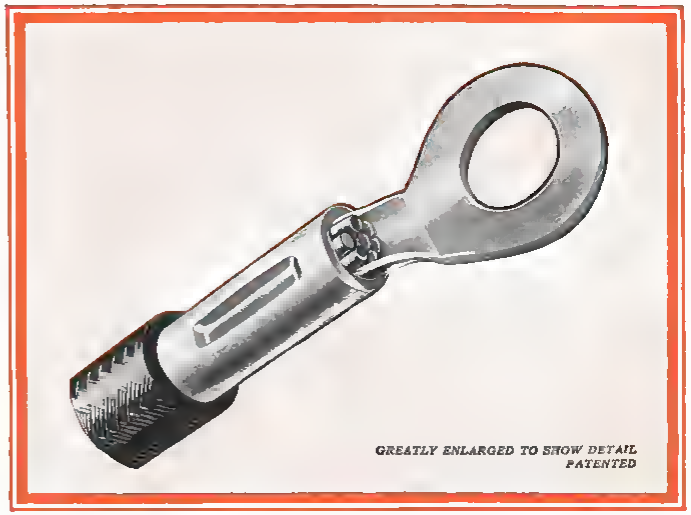
AIRCRAFT CORPORATION

CHICAGO, ILLINOIS



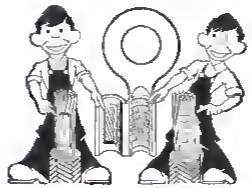
THE STA-KON TERMINAL

Preferred by the Aircraft Industry



The design of any mechanical wire terminal is concerned with just two vital factors:

1. **A high conductivity electrical connection, the resistance of which will remain constant as long as the terminal is in use.**
2. **A secure mechanical grip without injury to the wire strands, that provides high pull-out value.**



Dissection of a Sta-Kon installation reveals otherwise hidden facts: Serration impressions across the strands themselves indicate pressure exerted and area of contact. Corrosion and fatigue tests prove that the Sta-Kon connection is sound, both mechanically and electrically, and that initial, low resistance is unimpaired by age or service.

The T & B Sta-Kon performs far in excess of electrical and mechanical standards.

T&B

THE THOMAS & BETTS CO.

INCORPORATED

MANUFACTURERS OF ELECTRICAL FITTINGS SINCE 1899

ELIZABETH, NEW JERSEY

N ALL BATTLE AREAS ARE FOUND

BOMBER PILOTS *trained*



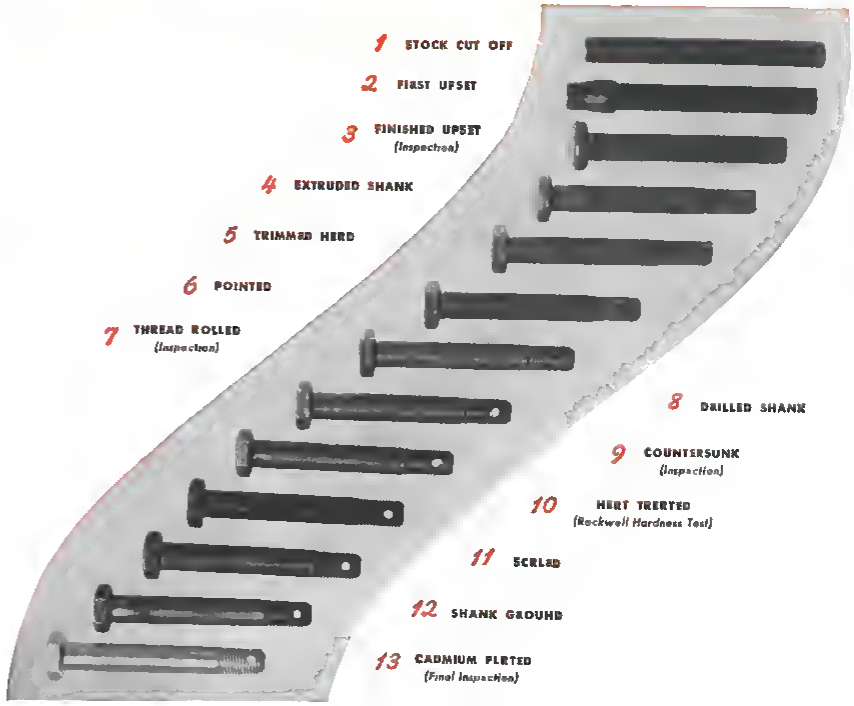
With

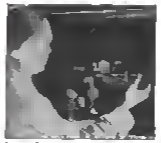
JACOBS AIRCRAFT *Engines*

The majority of twin-engine Training Planes in the United States and Canada are powered by JACOBS.

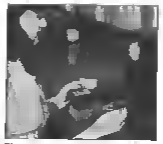
JACOBS AIRCRAFT ENGINE CO.

AN AN AIRCRAFT BOLT IS BORN...

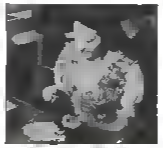




Thread form comparator used for checking form and lead—magnification 500 times.



Testing uniformity of anneal magnetically by means of a Cathode Ray Oscillograph.



Checking pitch diameter by means of roller snap gauge.



Hardness control by means of Rockwell testing machine.

The most important parts of a plane, to us who make them, are the fastening devices that hold it together. We view with admiration the thousands of other parts that go to make up one of these marvelous "war birds," but we take off our hats to nobody when it comes to quality.

The fact that we produce millions of individual pieces a day for aircraft use makes no difference. Each one must be perfect.

National HEADED AND THREADED PRODUCTS



THE NATIONAL SCREW & MFG. CO., CLEVELAND, O.



This is the HOME OF AERONCA.



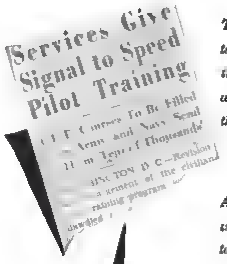
This is the famed ARMY GRASSHOPPER PLANE that we make in the HOME OF AERONCA.



These are the WORKERS of high pedigree who build the GRASSHOPPERS to keep U S free, that we make in the HOME OF AERONCA.

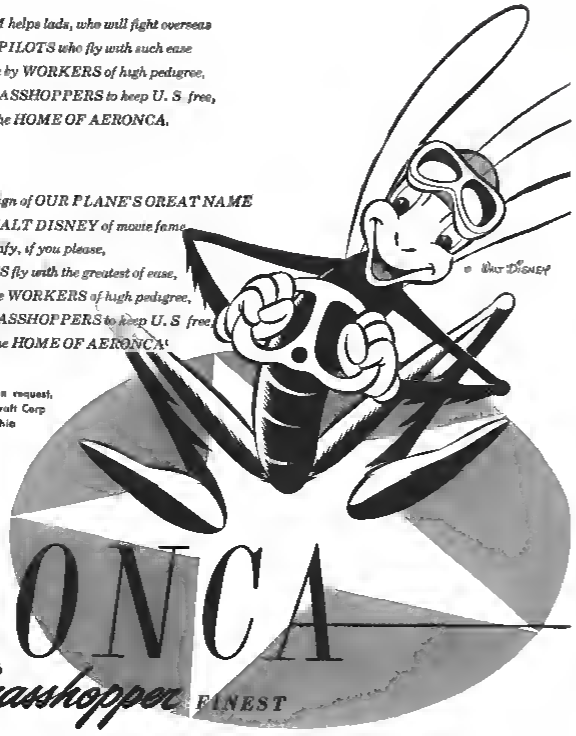


These PILOTS fly with the greatest of ease in the plane made by WORKERS of high pedigree, who build the GRASSHOPPERS to keep U S free, that we make in the HOME OF AERONCA.



This PROGRAM helps lads, who will fight overseas to learn from the PILOTS who fly with such ease in the plane made by WORKERS of high pedigree, who build the GRASSHOPPERS to keep U. S free, that we make in the HOME OF AERONCA.

And this new design of OUR PLANE'S GREAT NAME is by GRAND WALT DISNEY of movie fame to distinctly identify, if you please, the plane PILOTS fly with the greatest of ease, that is made by the WORKERS of high pedigree, who build the GRASSHOPPERS to keep U. S free, that we make in the HOME OF AERONCA!



Color reprints free on request. Write to Aeronca Aircraft Corp Middletown, Ohio

AERONCA

FIRST *Grasshopper* FINEST

© 1943—Aeronca Aircraft Corporation

SCOTT

KEEPS PACE WITH THE VICTORY DRIVE



Scott STEERABLE AND FULL SWIVEL *Tail Wheel Assemblies*

One of the most extensively used tail wheel assemblies on trainers, this Scott development (known as Model AST-8) is supplied in a wide range of models, for Aeroncas and other planes. Extremely light in weight, yet rugged and dependable. Exclusive dampner feature provides a dampening of the swivel action to prevent rotation in the air or the swivelling movement on the ground. Throughout every detail of construction, this Scott Tail Wheel Assembly is matched to the exacting demands of the Victory program.

PARTS LIST

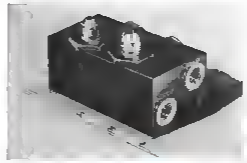
-01 Attaching Bracket complete with Swivel Bearing (s)
-01B Swivel Bearing (s) only
-02 Fork only (without steering arms)
-02S Fork only (with steering arms Attached)
-03 Attachable Rudder Arm to control Steering Action.
04 Connectors from Rudder Arms to Tail Wheel Assembly
-05 Dampner Assembly only (Wear Washer Brazed to the Nut).
06 Axle Assembly
-07 Pressed Steel Hub with Bearings (without tire)
08 Ball Bearings only, for Pressed Steel Hubs.
-09 Gurlock Grease Seals only
-010 6x2.00 Solid (Cushion) Tire.

Scott STEERABLE AND FULL SWIVEL *Tail Wheel Assemblies*



This husky, efficient Scott Assembly (Model CST-12) is standard equipment on all Piper Cubs and faithfully measures up to Piper performance. Here's the lightest tail wheel assembly made—long-time dependability is assured by individual static-testing of each assembly for shock resistance. Design embodies Scott dempening feature, plus all the other Scott structural advantages. This Scott contribution to Victory is daily proving its superiority.

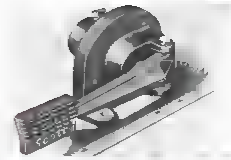
Scott OXYGEN MANIFOLD (M-78)



Patent Pending

This development by Scott engineering typifies Scott specialization in total aircraft accessories. Its function in oxygen system is to direct the flow of oxygen from no outside source to service tanks, from service tanks to the oxygen regulator or to other equipment. Prevents loss of total oxygen supply in event of direct tank hit. Designed to serve any number of tanks either centrally located or dispersed throughout the ship... Note compact construction—weight is only 15 ounces. Details promptly on request.

Scott BRAKE PRESSURE UNIT



Now ready for installation on PIPER CUBS. Designed and developed for use with hydraulic brakes on many types of aircraft, this SCOTT Brake Pressure Cylinder (B 711) is the simplest, most positive available for light aircraft. Weighs only 23 ozs. Can be supplied on A 1 J priority, (or better) with FULL, SIMPLE, INSTALLATION INSTRUCTIONS, showing mounting, under the seat, above the floor boards. Pedal location is similar to front brake pedal location. List price $24.75 per set of 2. Generous discounts to bona fide dealers.

Many other Scott accessories, now in production are of such a nature that they cannot be publicized....Scott is ready to study your particular accessories problem! Your inquiry will receive prompt attention.

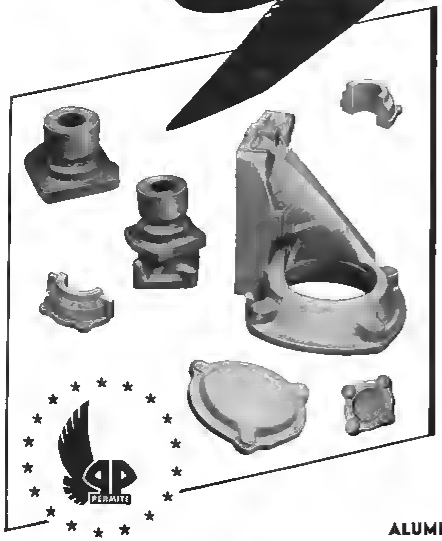
Scott AVIATION CORPORATION
DESIGNERS AND MANUFACTURERS OF SPECIAL EQUIPMENT FOR THE AIRCRAFT INDUSTRY

SUPPLIERS TO THE U. S. ARMY AND NAVY AIR FORCES AND LEADING AIRCRAFT MANUFACTURERS

Powered with ROLLS-ROYCE— to FIGHT and WIN!



Official Photograph
U.S. Army
Air Forces



IT'S NOT by chance that Curtiss picked the Packard-built Rolls-Royce engine to power the newest member of the famous series of P-40's! Curtiss engineers knew that the Rolls-Royce engine, battle-tested in the British Spitfires and Hurricanes, would give the Warhawk the power to fight and win!

Today, hundreds of vital parts in aircraft engine and air-frame construction are Permite Aluminum and Magnesium Castings, to provide the extra strength and light weight so essential to superior performance. Our production capacity has been multiplied many times, and our technical staff is collaborating closely with aircraft manufacturers in the record-breaking drive for more and better planes.

War production manufacturers are invited to consult with our engineering staff regarding their casting requirements.

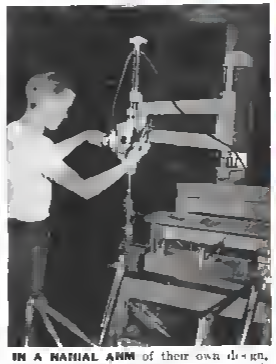
ALUMINUM INDUSTRIES, Inc., Cincinnati, Ohio

Detroit: 902 New Center Bldg. Los Angeles: 324 N. San Pedro St. Chicago: 616 So. Michigan Ave.

PERMITE ALUMINUM AND MAGNESIUM ALLOY CASTINGS



WAN WON'T WAIT so around a Black & Decker ¾ "Utility Drill Aircraft Mechanics, Inc., built this special device for dressing the side edges of bearings. The device pulls up instead of bearing down.



IN A RADIAL ARM of their own design, Aircraft Mechanics Inc., uses another Black & Decker Drill to do the work of a 48" radial drill press, for drilling operations on aircraft engine mounts.



IN ANOTHER "HOME MADE" JIG, on which a hand-turned thumbscrew exerts a pulling up action, a Black & Decker Utility Drill is used for dressing—or "spot facing"—the under sides of bearings.

When machine tools can't be had

Black & Decker Tools do the Job!

THEY COULDN'T GET THESE  SO HERE'S WHAT THEY DID!

AIRCRAFT MECHANICS, INC., needed equipment to start quantity production of welded steel structures for airplane engine mounts and landing gear . . . they couldn't get machine tools for months. But that didn't stop 'em! By combining ingenuity with Black & Decker Portable Electric Tools, they built their own special equipment—saved 3 to 4 months starting production. The pictures here tell the story.

The case of Aircraft Mechanics, Inc., is not unusual. We have just published a booklet showing how other ingenious war producers have combined brains with Black & Decker Tools—and built special equipment to do special jobs when machine tools were not available. It's called "They Used Their Heads"—and a copy is yours for the asking. Write: The Black & Decker Mfg. Co., 738 Penna. Ave., Towson, Md.

For Expert Help on any tooling problem, phone your nearby Black & Decker Distributor. He's ready to serve you quickly—with expert tool information—or as a dependable source of supply.



LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker

PORTABLE ELECTRIC TOOLS



"IT'S TOUGH IN THE HILLS—BUT THEY CAN TAKE IT!" says Aircraft Mechanics, Inc. Here they have used a Black & Decker Utility Drill in building their own horizontal drill press. According to their report, this outfit is very fast and is doing the same work as a big 60" radial drill press. A new free booklet—called "They Used Their Heads"—illustrates more such ingenious adaptations of B & D Tools. For a copy address: The Black & Decker Mfg. Co., Towson, Md.



Open for business

Somewhere today between Tokyo and Tulagi .. or Naples and Narvik .. bomb doors of hefty Vega Venturas are opening for the business of hitting the firm of Adolf Benito-Hirohito where it hurts—*plenty.*

Just where .. and just how .. communiques will tell—in stories of advance Jap air bases demolished, of vital Nazi shipping sunk.

For these are jobs Venturas were designed to do .. the kind of Axis-smashing jobs their veteran brothers, the Lockheed Hudsons, have long been doing. And these Venturas .. bigger, doubly-armed .. are more than keeping up the family tradition. They're improving it! Lockheed Aircraft Corporation, Vega Aircraft Corporation, Burbank, California



A subsidiary of Lockheed

Vega

Aircraft Corporation

Member Aircraft War Production Council, Inc.

Question every fastening job..



ASK — "Why Can't It Be Done the Simple Way . . . with time-saving P-K Self-tapping Screws?"

That question is standard practise with hundreds of engineers and production men who are trying to conserve vital time and labor. They put it to themselves, and to their associates . . . not only at the drafting board but also on the production line.

They don't expect Parker-Kalon Self-tapping Screws to be the best means of making EVERY fastening under ALL conditions. But they know that, for a *very large percentage* of metal and plastic fastening jobs, these Screws offer a combination of ease, speed and real security that no other fastening device or method can match!

How to Save Operations . . . to Save Vital Time and Labor

Make it *your* practise to see that you can't employ the simple Self-tapping Screw method before you put up with a more difficult one. Wherever P-K Self-tapping Screws can be used, operations will be eliminated, vital time and labor will be saved. You merely drive P-K Self-tapping Screws into plain, untapped holes. Such simplicity eliminates tapping and tap maintenance . . . solves the problem of getting scarce taps . . . stops fumbling with bolts and nuts and placing of lock washers . . . does away with inserts in plastics . . . cuts out riveting and welding in hard-to-get-at places.



Call in a P-K Assembly Engineer to check over fastening jobs with you. He can show you how to search out ALL opportunities to apply P-K Self-tapping Screws. And, he'll recommend them only when they will do the job better and faster. If you prefer, mail in assembly details for recommendations.

Change to Self-tapping Screws Over Night . . .

No matter what material you're working with . . . light or heavy steel, cast iron, aluminum, brass, plastics . . . you can adopt P-K Self-tapping Screws to advantage. And you can make the change-over without interrupting production. No special tools or skilled help are required. Parker-Kalon Corp., 192 Varick Street, New York, N. Y.

PARKER-KALON

Quality-Controlled

SELF-TAPPING SCREWS



Illustration: One of Solar's de-scaling acid baths

IT ALL BEGAN WITH TWO MANIFOLDS

In 1930, Solar estoblished the airplane exhaust manifold industry, when the U. S. Novy placed an order with the company for two experimental exhaust monifolds.

Todoy, 13 years later, the processes developed, the research carried an and the monufacturing methods created by Solar have made substantial contributions to America's rapid production af bombers, fighters and troiners for the United Nations.

SOLAR

EXHAUST SYSTEMS—

SOLAR AIRCRAFT COMPANY • SAN DIEGO, CALIFORNIA

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SPEED PRODUCTION
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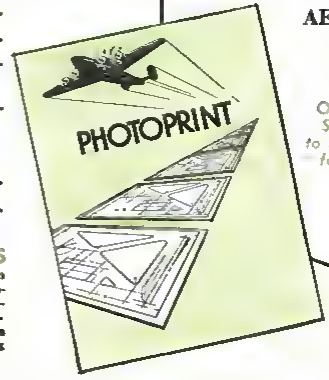
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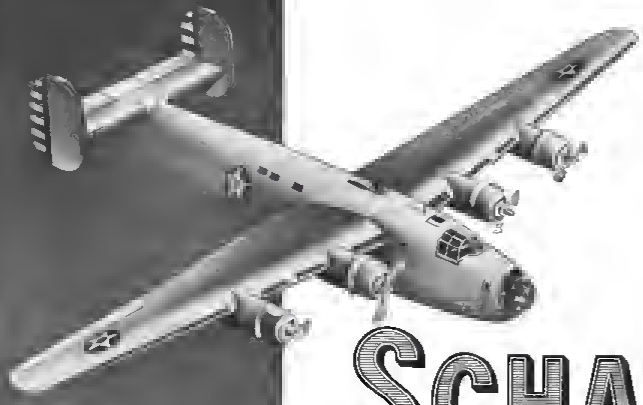
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FOR THIS BOOK

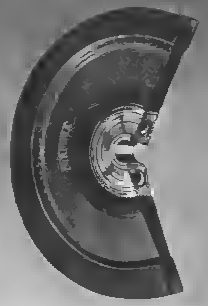
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NO OTHER CONTROL BEARING SURPASSES SCHATZ IN PERFORMANCE • NO OTHER CONTROL BEARING EXCELS SCHATZ IN CONSTRUCTION • DUAL INNER RACES PROVIDE GREATER BALL AREA • THIS GIVES GREATER CAPACITY • A FEATURE WHICH DISTINGUISHES ALL SCHATZ CONTROL BEARINGS •





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Detroit: 2640 Book Tower • Chicago: 902 S. Wabash Ave.
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Free Air FOR A FLYING FREIGHTER?

It is safe to say that the landing gear of the coming sky freighters won't look like this enlarged version of today's equipment.

However, regardless of what it looks like, the problems of tomorrow's landing gear and related devices are of material interest to the Aviation Division of Whiting Corporation. Whiting's Collateral Engineering Service is available to collaborate with the aircraft designer on the related problems of maintenance and handling . . . and have new equipment ready when the new planes need it. Write for information on this service.

WHITING
CORPORATION

Main Office and Plant 15623 Lathrop Ave., Harvey, Ill.
Western Office 6381 Hollywood Blvd., Los Angeles. Branches New York, Philadelphia, Pittsburgh, Detroit, Cincinnati, St. Louis

Quick Starting



BREEZE CARTRIDGE-TYPE ENGINE STARTERS

. . . Quick Action Under All Conditions

For dependable starting under all conditions, many of America's fighting aircraft rely on Breeze Cartridge-Type Engine Starters. Designed for use on aircraft engines ranging from 300 to 2,000 horsepower, this starter saves vitally important seconds in getting the aircraft off the ground. A touch of the switch sets the starter into action—slow burning fuel provides a steady torque to turn the engine over at the rate of 180 RPM. In action today on many battlefronts, the Cartridge-Type Engine Starter is but one of the many well known Breeze aircraft accessories that are serving the United Nations in this war against aggression.

Manufactured under Coffman patents

BREEZE MARK

BREEZE CORPORATIONS, INC.
Newark, New Jersey

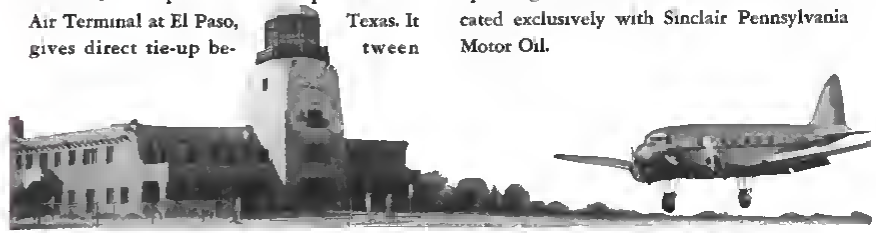
NEIGHBORLY WINGS—



Flagship service by American Airlines direct to Monterrey and Mexico City is a new expression of Good Neighborliness between United States and Southern nations.

This extension of through air service is a feature of the operation of the splendid new Air Terminal at El Paso, Texas. It gives direct tie-up between American's "South of the Border" air transportation and American's coast-to-coast air highway.

Like the rest of the nation's greatest overland air transport fleet, American Airlines Flagships operating out of El Paso Terminal are lubricated exclusively with Sinclair Pennsylvania Motor Oil.



FOR FURTHER INFORMATION ABOUT SINCLAIR PENNSYLVANIA AND OTHER SINCLAIR AIRCRAFT LUBRICANTS WRITE

SINCLAIR AVIATION OILS

SINCLAIR REFINING COMPANY (Inc.)

2540 West Cermak Road, Chicago • 10 West 51st Street, New York City • Rialto Bldg., Kansas City • 573 West Peachtree Street, Atlanta • Fair Building, Ft. Worth

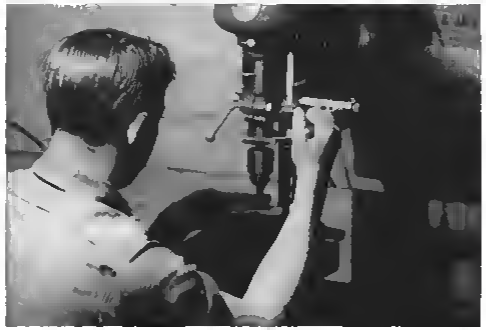
ARE THESE 3 SABOTEURS ON YOUR PAYROLL?



GLARE



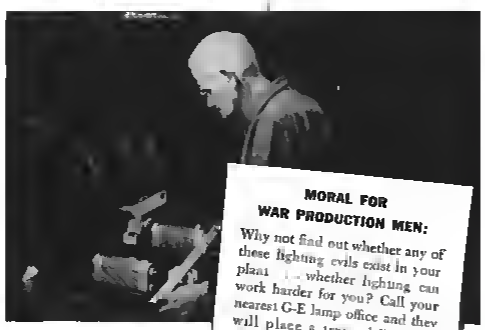
These 3 "Saboteurs" can slow up production on any night shift. First—and worst—is *glare* in workers' eyes. Glare from bare or poorly shaded lamps, or from shiny metal surfaces can hasten fatigue and breed spoilage and accidents. Glare can often be corrected merely by making a few simple changes in existing lighting.



SHADOWS



Shadows on the work are the bane of every mechanic's life. They make it almost impossible to work to the new close tolerances demanded in war production. The remedy may be supplementary lighting on machines. Or raising or lowering existing fixtures. Or both. A G-E lighting engineer can probably tell you the answer. And the last thing he has any idea of is to try to sell you a new lighting installation!



DIRT



Dirt on lamps, fixtures and walls can sabotage the best lighting ever installed! In some cases, light output of brand new G-E fluorescent lighting installations dropped off 50% in a short time simply because no one cleaned the lamps and fixtures. A G-E lighting engineer can help you start a regular maintenance program. Help you get full light from every dollar's worth of lamps and electricity!

MORAL FOR WAR PRODUCTION MEN:

Why not find out whether any of these lighting evils exist in your plant . . . whether lighting can work harder for you? Call your nearest G-E lamp office and they will place a trained Wartime Lighting Counsellor at your service. Or see your local electric service company or your G-E lamp supplier.

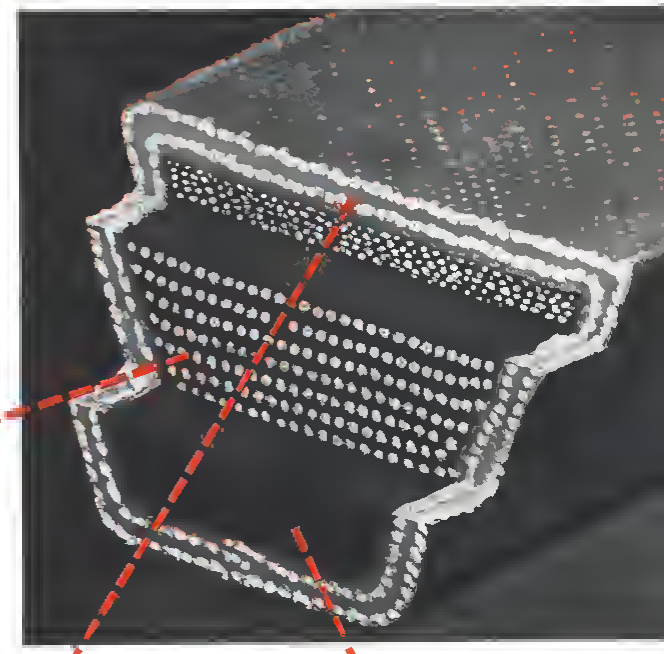
G-E MAZDA LAMPS

GENERAL ELECTRIC

Anatomy of Maintenance

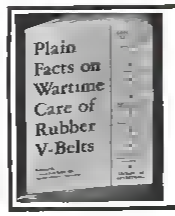
WARTIME V-BELT

You'll find this Cutaway of the new, advanced Texrope Super-7 well worth a Moment's Study . . . for how it's *Built* tells you a Lot about how to *Care* for V-Belts — whatever "Make" you Use! And proper Care of the rubber V-belts driving around 70% of America's production machines is a Wartime *must!*



V-Day needs every V-Belt

MUSCLE . . The 50% stronger cords and 20% *more* cords produced by the Flexon process give the new Texrope Super-7 extra muscle. To protect the pulling strength of *your* V-belts — regardless of their brand — keep them pulling *steadily* . . . without the slipping and grabbing that can jerk the life out of V-belts. That means keeping proper tension. Good rule-of-thumb for measuring it: "When struck with the hand, properly taut V-belts have an alive springiness."



Free!

Every engineer and executive should have a copy of this valuable new handbook in his technical library. It's packed with timely facts . . . applies to *all* makes of V-belts. Send for it today!

SKIN . . Texrope Super-7's tough, new Duplex-Sealed cover protects the inner belt structure against grit, grime and moisture. And what protects any V-belt's *cover* is — maintenance! So here are 3 rules for care of covers . . . 1. Keep grease or oil from reaching them — quickly remove it with a solvent if it does (*never* apply belt dressings to rubber V-belts!); 2 If gritty dust threatens abrasive wear, shield your V-belts, 3 Maintain proper tension to prevent slip and heating.

PAD . . Just as the bones of the human foot "ride" on the sole's pad of fat, so the pulling cords of a V-belt "ride" on a pad of rubber . . . which eases them around sheaves. Texrope Super-7's pad is of special, cool-running rubber which combats heat, dangerous enemy of rubber. You can fight heat by preventing misalignment in your drives. When present, it subjects the sides of V-belts to needless rubbing, sharply raises belt temperatures. So keep the shafts of drives parallel, sheave grooves in line.

☛ *When you do Need new V-belts, invest in the Best . . . Texrope Super-7!*

A 1545

ALLIS-CHALMERS

WE WORK FOR VICTORY — WE PLAN FOR PEACE

TEXROPE* SUPER-7 V-BELTS

*Trade-mark registered U.S. Patent Office. Texrope Super-7 V-Belts are the result of the cooperative research and effort of four great companies — Allis-Chalmers and A.C. Gaspardo — and are sold exclusively by Allis-Chalmers dealers in all parts of the U.S.A.



Titeflex *unimold

(Integrally Molded)

REG. U.S. PAT. OFF.

DETACHABLE AIRCRAFT LEADS

Quick acceptance followed the recent announcement of the TITEFLEX UNIMOLD lead for aircraft ignition systems. For this improved lead combines the feature of *detachability* . . . pioneered by TITEFLEX to *simplify* ignition maintenance . . with the new TITEFLEX integral molding process which *minimizes* maintenance by removing its major cause.

In the UNIMOLD lead the conductor is *preformed* within the tubing and end connections, and the entire assembly is then filled with an homogeneous, high dielectric material capable of withstanding the mechanical and electrical abuses present in aircraft service. Being thus *integrally molded* to shape, instead of having a loose cable drawn through and merely bent to shape as in conventional leads, the strains and cracks which cause premature ignition failures are eliminated.

Because of the added *security* and *serviceability* assured by this TITEFLEX development, UNIMOLD leads are fast replacing the conventional leads now in service, and are being supplied with new TITEFLEX detachable lead ignition harnesses.

UNIMOLDING is the latest, and one of the most important contributions resulting from the TITEFLEX policy of *continuing* research . . . a policy which keeps TITEFLEX the leader in aircraft shielding.

*U. S. PATENT NO. 2,123,166

TITEFLEX METAL HOSE CO. 510 FRELINGHUYSEN AVENUE NEWARK, NEW JERSEY

RADIO, POWER, AND IGNITION SHIELDING — CONDUIT, FITTINGS, COMPLETE ASSEMBLIES — HIGH PRESSURE FUEL, OIL, AND AIR LINES



Worry About My Boy? Of Course Not!



YOU CAN RELY ON LYCOMING AIRCRAFT ENGINES

Thousands of mothers, the country over, express confidence in America's training planes . . . confidence built upon the fact that their sons have safely come through hundreds of hours of intensive flight training in these ships.

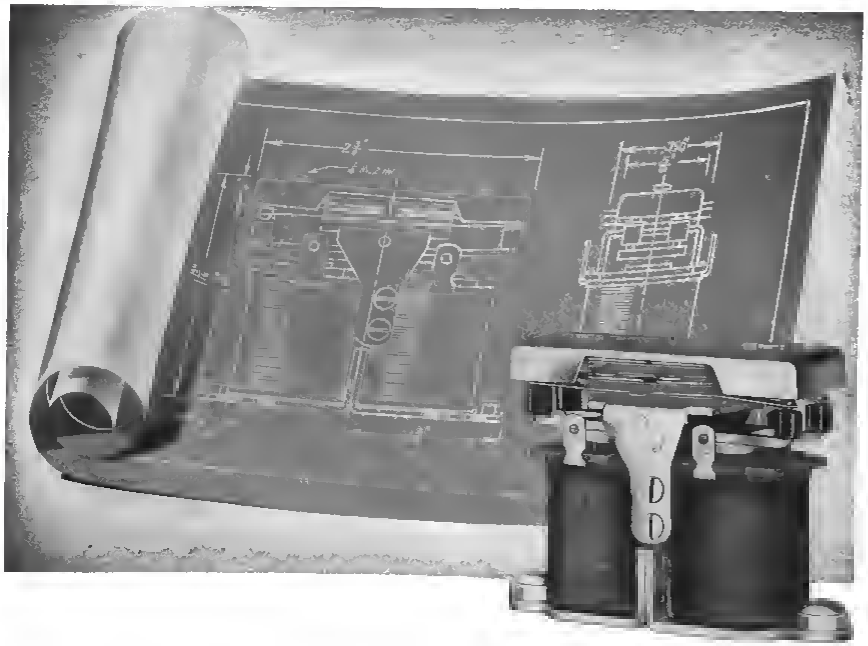
The steady, dependable operation of Lycoming engines has played a great part in assuring the safe flying that is inherent in America's training planes.

The Navy Spartan Trainer, shown above, is one of many Lycoming-powered planes used in training America's pilots . . . pilots who through long experience acclaim Lycoming to be the synonym for dependability in both military and civilian aviation.

Contractors to the U. S. Army and Navy

THE TRAINING PLANE ENGINE OF TODAY... THE PRIVATE PLANE ENGINE OF TOMORROW

LYCOMING DIVISION, THE AVIATION CORPORATION WILLIAMSPORT, PA.



Yesterday's Standards Won't Do!

The adaptation of standard parts in varying combinations in lieu of specialized designing does not always satisfactorily meet today's exacting, frequently changing requirements. Yesterday's standards do not always fit present needs.

Forty years of experience in the design and manufacture of electrical equipment has thoroughly fitted this organization to build electrical apparatus to fill specific and immediate needs.

With a corps of skilled engineers, ample laboratory and testing facilities, fine machine tools, and an extremely modern system of production control which helps speed delivery, this company is extremely well equipped to design to rigid specifications; to tool up without unnecessary delay, and to fabricate in quantity and completely under one roof.

The relay illustrated above is an example. It is a two-way relay having a balance of armature control, and is an excellent double action interlock control unit. It is precision built. It has many distinctive features too numerous to list here. It is available in various contact arrangements with capacities up to 5 amperes, 110 V. A.C. rating, coil capacity 10,000 ohms, each; contact forms or assemblies up to 12 springs on each side, and occupies a limited space of only 2¾" long x 1⅝" high x ⅜" deep.

If you have a problem where yesterday's standards won't do, phone us immediately, stating your requirements, and our engineers will cooperate speedily and effectively.

COOK ELECTRIC COMPANY
2700 Southport Avenue • Chicago, Illinois

Cook Electrical Equipment *and* Aeronautical Accessories



★ Wherever the strategy of global warfare takes America's gallant pilots, they confidently rely on Aerols for perfect landings and take-offs.

Aided by Aerols, some of these men land the biggest bombers with effortless ease on the scorching sands of North Africa. Others, piloting the fiercest fighters, rely on Aerols for swift, sure take-offs on runways hacked out of the Australian bushland.

Because of their outstanding performance on every terrain and in every climate, Aerols are famed throughout the entire world of aviation.

Ask the pilots who land on them!

THE CLEVELAND PNEUMATIC TOOL COMPANY
AIRCRAFT DIVISION • • **CLEVELAND, OHIO**

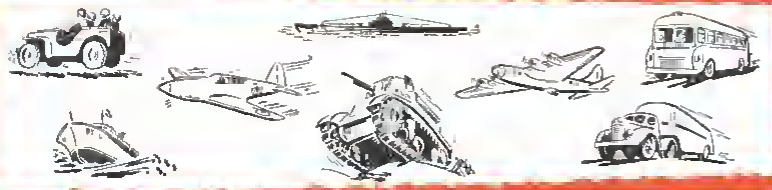
Also Manufacturers of Cleco pneumatic tools for the aircraft and general industry, Cleco shankholders, Cle Air shock absorbers for trucks and buses, and Cleveland rock drills for mining and construction work.

AEROLS*

*THE SHOCK ABSORBING UNITS ON AN AIRPLANE'S LANDING GEAR; THE NAME IS DERIVED FROM THE WORDS "AIR" AND "OIL"—THE FLUIDS USED TO DISSIPATE THE LANDING SHOCKS

SIOUX TOOLS

a name to reckon with!



in either production
or maintenance

SIOUX TOOLS INCLUDE:

Electric Drills — Bench Grinders
Portable Electric Grinders
Portable Electric Sanders
Portable Electric Polishers
Phenol Abrasive Discs
Grinding Wheels — Flexible Shafts
Wire Wheel Brushes
Valve Face Grinding Machines, Wet Grinders (Aviation and Automotive)
Dual Action Aviation Valve Seat Grinder (Dry)
Dual Action Valve Seat Grinder (Automotive)
Wet Valve Seat Grinding Machine for Aircraft Radial Motors

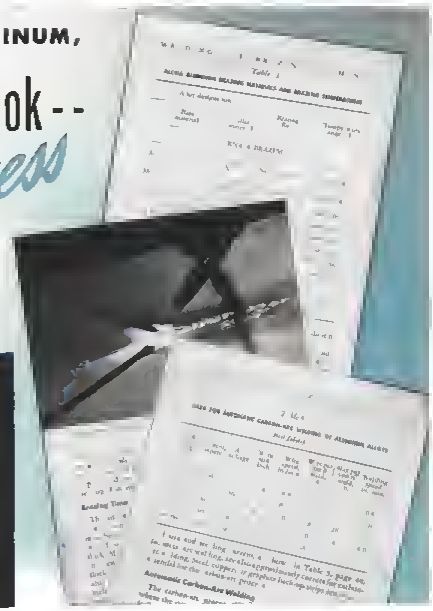
WRITE FOR FURTHER PARTICULARS

STANDARD THE WORLD OVER
ALBERTSON & CO., INC. SIOUX CITY, IOWA, U. S. A.

IF YOU'RE WORKING WITH ALUMINUM,

you should have this book--

just off the press



WELDING
AND BRAZING
ALCOA ALUMINUM

Here's a book of data designed to meet the needs of the practical man—the welder—who is working with Aluminum Alloys. It describes in detail the practices now widely employed for joining Aluminum parts by gas welding, arc and resistance welding, and by brazing.

This book is planned to assist the war effort by making every welder more proficient at his job. Typical subjects covered are Welded joint design—preparation of parts—types of welding equipment—electrodes and fluxes—tip selection and flame adjustment—inspection and finishing—strengths of welds.

Joining Aluminum Alloy parts by welding and brazing is readily mastered with knowledge like this at your command, plus a little practice. You may have this book free. Use the coupon to send for your copy today.

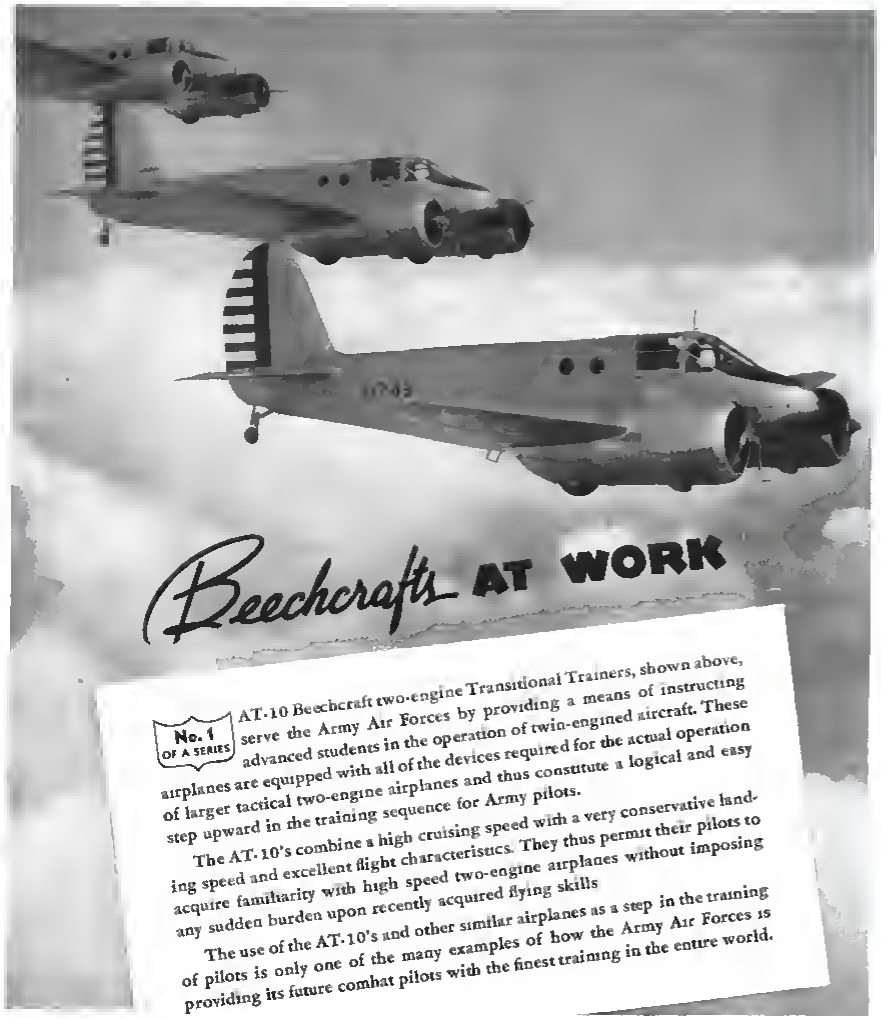
ALCOA

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA,
2132 Gulf Bldg, Pittsburgh, Pa
Please send me this new book.



Name_____
Company_____
Street_____
City_____



Beechcrafts AT WORK

No. 1 OF A SERIES

AT-10 Beechcraft two-engine Transitional Trainers, shown above, serve the Army Air Forces by providing a means of instructing advanced students in the operation of twin-engined aircraft. These airplanes are equipped with all of the devices required for the actual operation of larger tactical two-engine airplanes and thus constitute a logical and easy step upward in the training sequence for Army pilots.

The AT-10's combine a high cruising speed with a very conservative landing speed and excellent flight characteristics. They thus permit their pilots to acquire familiarity with high speed two-engine airplanes without imposing any sudden burden upon recently acquired flying skills

The use of the AT-10's and other similar airplanes as a step in the training of pilots is only one of the many examples of how the Army Air Forces is providing its future combat pilots with the finest training in the entire world.

Beech Aircraft CORPORATION

BEECHCRAFTS ARE DOING THEIR PART — *WICHITA, KANSAS, U. S. A.*



Used by Wright Aeronautical for testing "Cyclones" since 1932

WOLF'S HEAD
MOTOR OIL AND LUBES

Thousands of Wright engines, now powering many types of 'planes for the United Nations, made their test runs with Wolf's Head Oil—the 100% Pennsylvania motor oil that has constantly kept pace with the progress of aviation engineering.

WOLF'S HEAD OIL REFINING CO., OIL CITY, PENNA., NEW YORK, N. Y.

MAKING *News* WITH THE R. A. F.!



Photo courtesy North American Aviation, Inc.

The boys in the R.A.F. say . . . "It's the airplane without a mistake"! And rightly so . . . for the "Mustang" is a fast, tricky fighter built to resemble a slim streak of light Sensitive, sure-acting controls give it the ability to twist through the air like a swallow. It's hard to hit but hard-hitting! Here, again, Fafnir Aircraft Ball Bearings . . . on the control system . . . help add the *plus* that means greater performance.

It's no accident that "Fafnirs on the controls" has become a byword among plane builders. Many of the control features that give American-built aircraft the edge in battle today, are the result of long-range cooperation of Fafnir engineers with the aircraft industry. These engineers have worked to provide ball bearings that assure a stability, rigidity, and friction-free responsiveness for high-powered planes that is not matched by any other type of bearing. The Fafnir Bearing Company, Aircraft Division, New Britain, Connecticut.

ARMY-NAVY

Send for copies Fafnir Aircraft Service Manual, you will find it an invaluable service guide



FAFNIR

Ball Bearings

for Aircraft

Impact Strength



The Air Forces have it . . . and LUMARITH has it!

Impact strength—the ability to deliver a stinging punch and the toughness to take it! Yes, the men of the sky have it! And in many cases, the cockpits of their 'planes and gliders are enclosed with transparent Aero-Quality Lumarith, the plastic with outstanding impact strength.

Lumarith molding materials, as well as transparent sheets, are giving 'plane and glider parts military stamina at high and low temperatures.

Because Aero-Quality Lumarith Sheets can be formed in single curvatures without heat, replacement after battle is made easy when panel designs take full advantage of this Lumarith property.

LUMARITH

Plastics

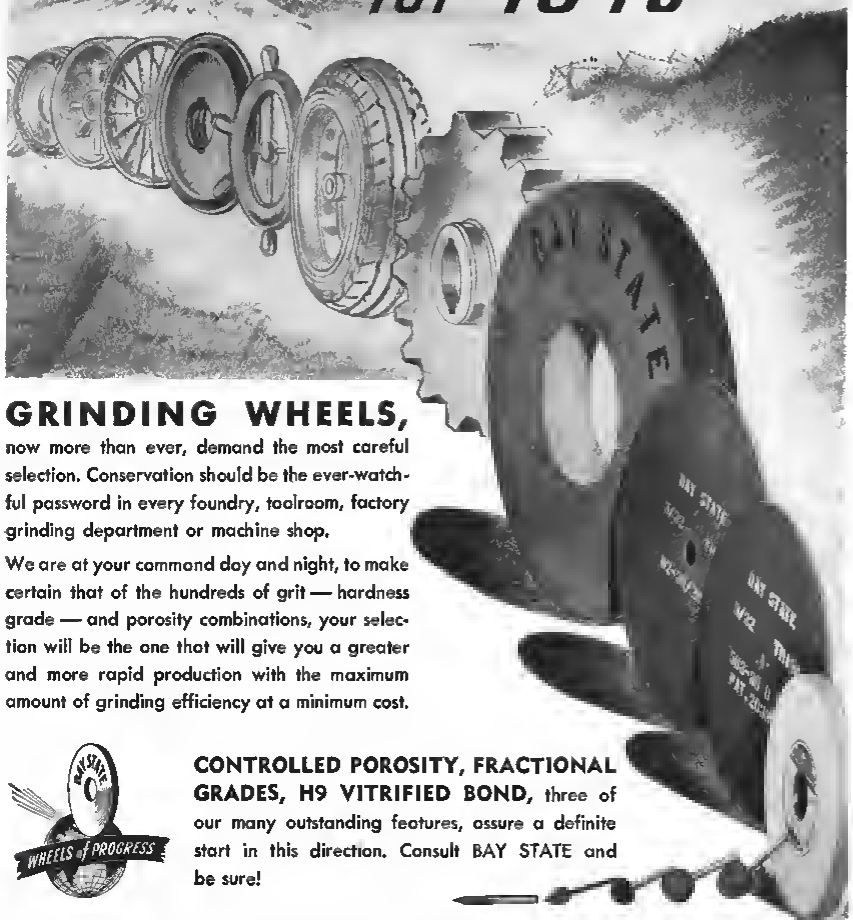
CELANESE CELLULOID CORPORATION

Celanese Celluloid Corporation, 180 Madison Ave., New York City, a division of Celanese Corporation of America Sole Producer of Celluloid* (cellulose nitrate plastics, film base and dopes) Lumarith* (cellulose acetate plastics, film base moisture laminating and transparent packaging material and dopes) — Lumarith* F. C. (ethyl cellulose molding materials) — *Trade-marks Reg. U. S. Pat. Off. Representatives: Dayton, Chicago, St. Louis, Detroit, San Francisco, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto, Ottawa.

The First Name in Plastics

A DIVISION OF CELANESE CORPORATION OF AMERICA

WHEELS of PROGRESS for 1943



GRINDING WHEELS, now more than ever, demand the most careful selection. Conservation should be the ever-watchful password in every foundry, toolroom, factory grinding department or machine shop.

We are at your command day and night, to make certain that of the hundreds of grit — hardness grade — and porosity combinations, your selection will be the one that will give you a greater and more rapid production with the maximum amount of grinding efficiency at a minimum cost.

CONTROLLED POROSITY, FRACTIONAL GRADES, H9 VITRIFIED BOND, three of our many outstanding features, assure a definite start in this direction. Consult BAY STATE and be sure!

BAY STATE

ABRASIVE PRODUCTS CO., WESTBORO, MASS. U.S.A.

THE RESCUE OF RICKENBACKER



The Date:

November 13, 1942

The Scene

A choppy South Pacific sea, 600 miles north of Samoa

Rescue Plane:

A Vought-Sikorsky "Kingfisher" scout-observation seaplane, equipped with Edo Float gear and piloted by W. F. Eadie, Lt., U.S.N.

Rescued after twenty-one days on a rubber life raft:

Capt. E. V. "Eddie" Rickenbacker, Col. Hans C. Adamson and Pvt. John F. Bartek.

Note.

After the rescue, the heavily overloaded 2-place seaplane withstood the gruelling test of taxiing 5 people to safety through 40 miles of choppy sea.

EDO AIRCRAFT CORPORATION
College Point
Long Island, N. Y., U. S. A.

It pays to standardize on "HALLOWELL"



"Joe tells me you doubled your assembling capacity. Built an addition?"

"No—just re-arranged our 'Hallowell' Work Benches. It's easy as pie."

One of the advantages of standardizing on "Hallowell" is that you can re-arrange and add to your set-up at any time to meet greater needs or changed requirements. They are of sturdy construction and easy to install, too. Our catalog shows many of the 1367 combinations available.

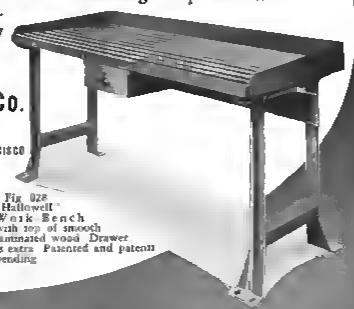
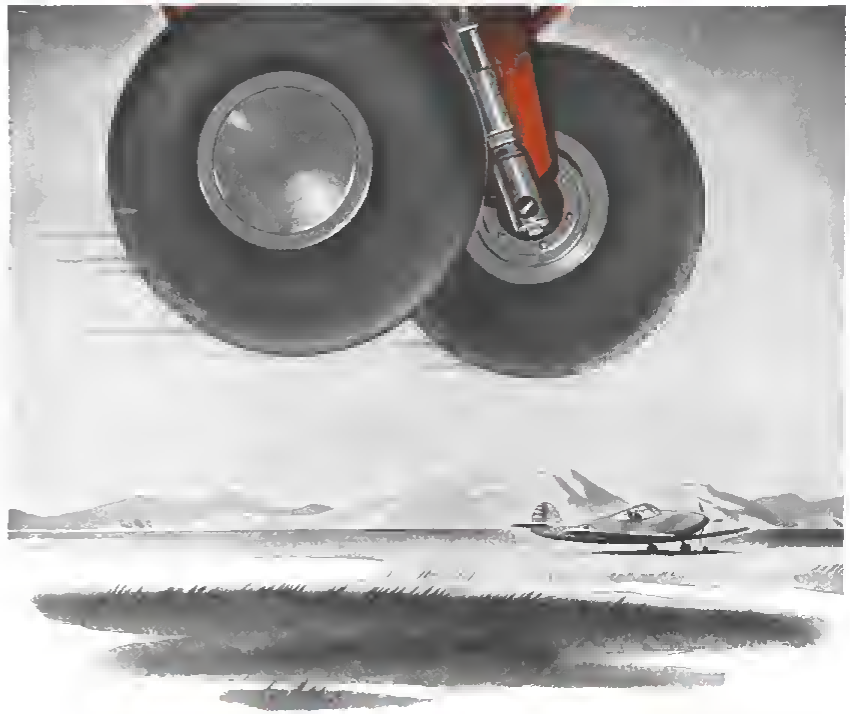


Fig. 028 "Hallowell" Work Bench with top of smooth laminated wood. Drawer is extra. Patented and patents pending.

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. BOX 368
— BRANCHES —
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HALLOWELL
SHOP EQUIPMENT



What is an impact actuator?

WHEN an airplane crashes an odd thing happens. A device that helps save the plane springs into action!

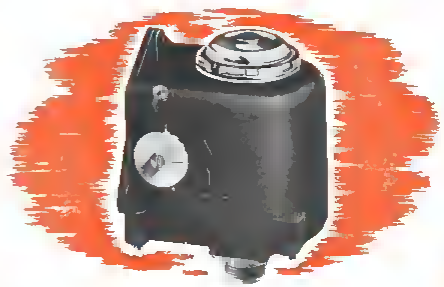
This device is the Kidde Impact Actuator. It acts automatically in the split second that separates safety from disaster. For example, it releases fire extinguishers at the exact instant of impact. Only an actual crash can trip the Actuator. Normal operating shocks, and hard landings have no effect.

Newly developed, the Kidde Impact Actuator meets difficult specifications. The crash force operates an electrical switch which actuates extinguishers, disconnects fuel lines, shuts off electrical circuits, does other jobs which can be handled by a switch or valve.

Walter Kidde & Company, peacetime maker of Kidde* carbon dioxide fire extinguishers, now aids war effort by producing such products as airplane flotation gear, life vests, oxygen-breathing cylinders, valves; vapor dilution systems, marine smoke detecting, extinguishing systems, inflation equipment for "rescue rafts". (Because these products keep us busy, we cannot fill low priority orders for industrial fire extinguishers.)

If you have a war-product problem which Kidde Impact Actuators will solve, write us. We'll help work it out.

*Formerly known as "LUX" extinguishers



Kidde

Walter Kidde & Company
Incorporated
122 West St., Bloomfield, N.J.

DOUBLE YOUR PRODUCTION

With the new

WILSON "HONEY BEE"

ARC CONTROL STATION



Photo courtesy of Republic Aviation Corporation

By connecting two or more Wilson "Honey Bee" Arc Control Stations to one constant potential arc welding generator you can double or triple your welding production without additional generators. At the same time you assure better quality welds on light or heavy gauge metal because of the finer arc control provided by the Wilson "Honey Bee."

Several 150 amp or 75 ampere Wilson "Honey Bees" can be connected to one 300 amp constant potential arc welding generator up to the maximum load capacity of the generator. This multiplies the number of welding operations that can be performed simultaneously from a single generator, thereby increasing the welding output of [illegible] machine. A better load factor results, with more welding for every K.W.H. of power purchased.

Operators at each Wilson "Honey Bee" station have full control over their individual welding current. Changes in individual welding currents do not affect other stations working from the same generator.

Infinite adjustments of current may be made without production delays by means of a remote control switch which may be combined with the electrode holder. Wilson Crater Control provided with each "Honey Bee" Station fades out the arc slowly to prevent craters, porosity and gas pockets that result from the abruptly broken arc.

For full details on the new Wilson "Honey Bee" Arc Control Station write for Bulletin ADW-47 or get in touch with your nearest Air Reduction Sales Office.

WILSON WELDER AND METALS CO., INC.

General Offices: 60 East 42nd Street, New York, N. Y.

OF HIGH-QUALITY WELDS

Get Maximum Work From Your Machines and Materials

Here are valuable pointers to help you conserve electrodes and increase production



ELECTRODES

1. For vertical and overhead welding use an A W S E 6010 or E-6012 type electrode. This type of electrode produces little slag so that there is a minimum of interference with the operator's manipulation of the electrode.

In addition it produces a large amount of "gas" which protects the molten metal from oxides and nitrides in the air.

2. For groove welding in flat position and horizontal fillets use a hot rod—one that produces a heavy slag, such as A.W S E-6020 and E-6030. Hot rods for "downhand" welding will increase the welding speed up to 200%-300%, since the high currents that can be used will permit increased penetration, higher burn off rate and a higher deposition rate.

MACHINES

1. Keep the machine protected from weather exposure at all times. Most welding machines are drip proof but not water proof. Do not store machine in a room where paint spray, dust, metal particles or foundry dust may be blown around.

2. Be sure that bearings are properly greased. Refer to manufacturer's operating instructions.

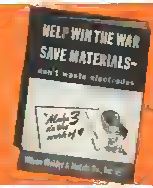
3. Do not overload your machine. For instance, do not use the machine continuously above its rated capacity. This is a harmful practice that decreases the life of your machine and results in overheating and charred insulation. Selection of proper size welding cables is important because excessive voltage drop in cables will result in overloading.

4. Check the brushes periodically to be sure they make proper contact with the commutator.

5. Check all connections regularly to insure perfect contact. Loose connections may cause erratic operation of the machine and unnecessary delays in production.

CONSERVE WELDING ELECTRODES

Write for free copies of this helpful booklet. It contains six shop bulletins emphasizing important ways to prevent electrode waste.





Tough Planes need Electrical Wiring that's just as **Tough!**

That's the reason for Specification AN-J-C-48.

● And that's the reason, here at the Wire Division of Electric Auto-Lite, that we're particularly proud of the "B" Braid Synthetic we have engineered and are manufacturing for aircraft primary circuits, from 22 Ga. to 00 Ga.

"B" Braid Synthetic *is* tough.

It meets all AN-J-C-48 requirements—and beyond that, its special "B" Braid construction (plus "CA" lacquer) gives it an abrasion resistance far beyond that of other constructions. It is an abrasion resistance useful not only in actual service, but in assembly and installation, as well.

Lightness of weight, and compactness in O.D. in relation to gauge, also commend Auto-Lite Sterling "B" Braid Synthetic to all users of aircraft primary wire. And if you need "harnesses," produced within the same factory, Auto-Lite Sterling has the experience, facilities, and skilled workers, to pre-fabricate them for you.

THE ELECTRIC AUTO-LITE COMPANY • *WIRE DIVISION* • PORT HURON, MICHIGAN

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AVIATION *ELECTRICAL* WIRES AND CABLES



GULF CUTTING OILS

help war industries get

increased production

longer tool life

better finishes

ENGINEERED to meet the production requirements of *today*, improved Gulf Cutting Oils are helping set new standards of machine tool performance in many plants!

Combining the best possible lubrication and effective cooling in the cutting and tool-chip contact areas, Gulf quality cutting oils are contributing to faster and more accurate machining, longer tool life, and improved finishes on the work. Production increases in many cases are truly remarkable!

A new booklet, which provides the facts on improved Gulf Cutting Oils — plus a useful 24-page Machining Guide section—is now available to plant men. Write for your copy today. Gulf Oil Corporation, Gulf Refining Company, Gulf Building, Pittsburgh, Pa.

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Please send me, without obligation, a copy of the new booklet, "Gulf Cutting Oils," which includes a 24-page Machining Guide.

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WINGED FOR VICTORY

Are Equipped with



NORMA-HOFFMANN

Precision bearings

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In these transports of Pan American and its affiliated companies—as in the fighting planes and bombers on every war front—NORMA HOFFMANN PRECISION BEARINGS are proving their dependability *"where the bearings MUST NOT fail"* In the control mechanisms, instruments and other vital plane accessory equipment, they are rendering that trustworthy performance which enables Pan American to "keep 'em flying"



NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN. . . FOUNDED 1911

Write for the Catalog Let our engineers work with you



Added Machine Hours—FREE!

Machine setup time takes its toll of production and no one can banish the thief. But with **HECKER** tools you CAN cut the time needed for setting up, and so increase the production time of your machines.

We can't hang "E" banners on **HECKER** tools, although they deserve it. But we are helping others to earn and fly this proud flag, by *designing* and *building* tools, jigs and fixtures to speed up exacting production jobs. We can put the same know-how into your tools—for added hours of machine output.

Our engineers rub elbows daily, in our own shop, with the problems of precision parts production—specifically, parts for leading aircraft manufacturers. They know men and machines and how they work together on an endless variety of job requirements That's the extra something that goes into every **HECKER** tool.

The best way to know **HECKER** service is—give us a tough tooling job to handle and let us demonstrate. Write A. W. Hecker, 1978 East 66th Street, Cleveland, Ohio, or 517 New Center Building, Detroit, Michigan.

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DESIGNERS AND BUILDERS OF TOOLS, JIGS AND FIXTURES—FABRICATORS OF AIRCRAFT PARTS



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Clear and intelligible directions, spoken over radiotelephone equipment, may mean success or failure to a military operation . . . a soldier's life or death. Our fighting men, though separated by vast distances, are closely linked . . . their actions coordinated by the lifeline of radio communications.

With production racing against time, Jefferson-Travis is developing new engineering designs and advanced manufacturing techniques to speed more improved radiotelephones into front line service with the United Nations. After victory, our equipment will serve the safety and convenience of free men throughout the world.

JEFFERSON-TRAVIS RADIO MFG. CORP.

Manufacturers of Aircraft, Marine and Mobile Radio Communication Equipment

NEW YORK, N. Y. WASHINGTON, D. C.

RELAYS

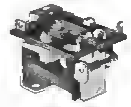
FROM GUN BLAST HEAT TO ARCTIC COLD

★ Smothered in dust . . . seared by gun blast heat . . . shrouded in fog . . . gripped by stratosphere cold . . . shaken by blasts of bomb and shell . . . these are daily incidents in the life of a relay. Under these conditions Relays by Guardian have already "proved their metal."

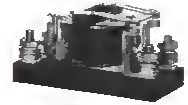
TRE SERIES 195 RELAY weighs less than an ounce! But don't let its tiny size fool you. It shrugs off the most severe vibrations likely to be encountered in aircraft. And it's especially adaptable to jobs where space as well as weight is at a premium. It's about wrist watch size in length and width—and not a great deal thicker.

TRE B-2-A RELAY designed to U. S. Army Air Force specification No. 94-32185-C is playing a big part in America's air offensive. It can take lashing punishment . . . has the ability to handle its specific job efficiently.

While thinking, building and engineering the tools of war today, Guardian is also looking ahead to peacetime applications of Relays, Solenoids, Electrical Controls of all kinds. If you are planning for the future, write us—our wartime experience can help you build better peacetime products.



Series 195 Relay. *One of the smallest relays made. Write for new Bulletin*



B-2-A Relay. *Designed for specific aircraft application. Write for new Bulletin*

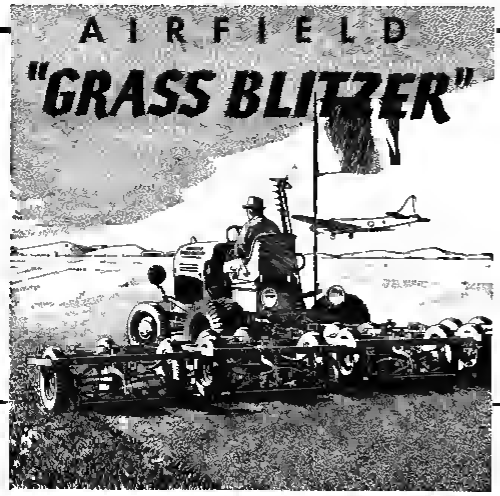
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A COMPLETE LINE OF RELAYS SERVING AMERICAN WAR PRODUCTION

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AIRFIELD
"GRASS BLITZER"



THE FASTEST WAY TO KEEP AIRFIELD GRASS CUT
to "keep 'em flying!"

— and the most dependable, efficient and economical method available for maintaining airfield mowing schedules is the Worthington Airfield "Grass Blitzer."

The "Grass Blitzer" is a team consisting of a powerful high-speed tractor and a revolutionary type gang mower. The tractor is capable of pulling a 9-gang Mower, cutting a swath of 21½ feet, at a speed of 20 miles per hour. Field conditions naturally affect practical operating speeds. Experience has shown that average speeds of 15 miles per hour can be maintained under normal conditions. At this rate the "Grass Blitzer" team will cut *35 acres* per hour, a grass cutting capacity over three times greater than any other make of tractor and gang mower combination now available.

If you have Airfield mowing and turf maintenance problems, why not consult with us today? Write or wire:

WORTHINGTON MOWER COMPANY · Home Office: Stroudsburg, Pa.

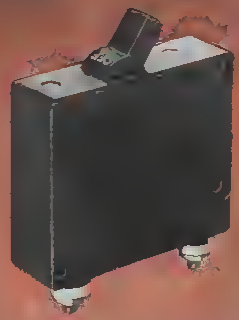


HEINEMANN AERO-MAGNETTE
CIRCUIT BREAKERS for AIRCRAFT

Off the flat tops of mountains patrol on to strike a quick blow at the enemy—into the clear blue or through thick "pea soup"—many of our aircraft depend on HEINEMANN "AERO MAGNETTE" Magnetic Circuit Breakers for the efficient protection of lighting, radio, motor and control circuits. To get a job like this they passed these rigid tests

20% Salt Spray at 120° F	93% Relative Humidity at 100° F	Immersion in Water held at 80° F.

On top of that these breakers perform with high efficiency in temperatures ranging from 50° below Zero up to 200° F. Send for complete descriptive literature



SIZE
2⅝" High
2¾" Long
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HEINEMANN CIRCUIT BREAKER CO.
Subsidiary of Heinemann Electric Co Est. 1888
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Easing the Strain On a Bomber Crew in Action

Simplifying the handling of a bomber in action means more time for concentration on the target. That's why Emerson-Electric builds Aircraft Motor Controls to precision standards —to respond *instantly* in the pinches—to do many split-second jobs dependably—to provide extra time for combat hands to fight the war.

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A PAGE FROM AVIATION'S HISTORY

United States carrier-based bombers blasting one of eight Japanese bases in the Marshall and Gilbert Islands

OFFICIAL U. S. NAVY PHOTOGRAPH

EMERSON ELECTRIC

5 H.P. and Smaller ELECTRIC MOTORS FOR AIRCRAFT



LIGHTWEIGHT COMPACT POWERFUL—Aircraft Motors are only one of Emerson-Electric's contributions to Winning the War.



Orthodox fighters and mystery ships, alike, are usually finished with Berry Brothers primers, lacquers and camouflage materials. Other features of design may vary, but the industry-wide preference for Berryloid Finishes is a constant. The most famous American and Canadian fighters and bombers are Berryloid-finished. The quality and uniformity of Berryloid finishing materials contribute much to victory-bent allied plane production.

BERRY BROTHERS

DETROIT, MICHIGAN • WALKERVILLE, ONTARIO

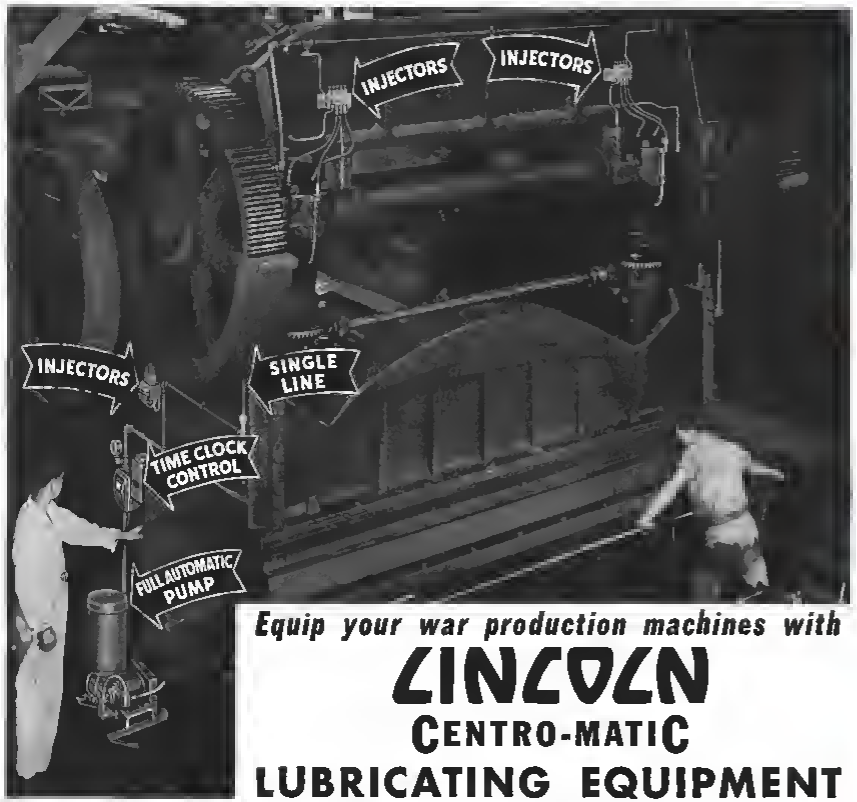
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LET'S GO! KEEP 'EM FLYING!

BERRYLOID AIRCRAFT FINISHES

KEEP WAR PRODUCTION GOING AT TOP SPEED

by automatically lubricating all bearings on your machines



Equip your war production machines with

LINCOLN CENTRO-MATIC LUBRICATING EQUIPMENT

You can save man-power and man-hours, and at the same time cut down on bearing failures which prevent delays in producing war orders. How?... By automatically lubricating *every* bearing on a machine with a Lincoln Centro Matic Lubricating System.

A Centro-Matic System consists of a number of Centro Matic Injectors—one for each bearing—and a hand operated or a power operated Centro-Matic Lubricant Pump. A power operated system can be semi-automatic or it can be full automatic. The injectors can be grouped in manifold or located separately at each bearing. In either arrangement only a single lubricant supply line is required.

One of these systems is easily installed on new or old machines, and makes it possible to lubricate all bearings from a single source. Permits machines to run 7 days and 7 nights a week without taking time out for lubrication service... Write for details.

142-32

ARMY-NAVY PRODUCTION AWARD

for high achievement in the production of war equipment has been conferred upon the Lincoln Engineering Company. It serves as inspiration toward greater and greater accomplishment until the time of final and complete Victory.

★BUY U.S. WAR BONDS★ **LINCOLN ENGINEERING COMPANY • ST. LOUIS, MO.**











Interstate

IS MANY THINGS TO MANY PLANES

This, the finest Precision Plant in the West, is not only on a war footing but a flexible footing. Gears shift fast... for Interstate is many things to many planes.

No matter what the day's requirements... from the smallest valve to the largest landing gear mechanism... Interstate's 24-hour shift meets the challenge.

To such top-flight performers as Douglas, Lockheed, Martin, Boeing, Consolidated, North American and others, Interstate delivers a steady stream of vital aircraft units... produced by craftsmen schooled and skilled in fine-gauge work.

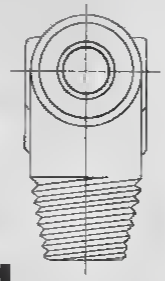
Whether it's bomb shackles for the big ships that sweep the Axis sky... or mechanical and hydraulic gun and cannon chargers... or hydraulic actuating mechanisms... Interstate delivers!

And, in addition, Interstate delivers complete military planes to the United States Army Air Force and the Navy. The new L-6 pictured here adds emphasis to the fact that Interstate is many things to many planes... including planes of its own design! Interstate Aircraft and Engineering Corporation.

EL SEGUNDO, CALIFORNIA

When Victory Hangs by a Thread







Precision

ALL-OUT PRODUCTION

A critical job at a critical time!—That's Dole's part in the war program. Production must be "all-out"—and, we have made it so.

But that is not enough. The degree of precision which Dole engineering and manufacture have attained must be made standard and not at any point relaxed for the sake of the speed and volume of all-out effort. This, too, we have done.

Is this patriotism? Yes, but more. It is an inner conviction that Victory is won eventually by excellence in little things—even as small as the screw threads of one Dole Aircraft Fitting selected at random from the millions.



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Dole Thermostats

THE DOLE VALVE COMPANY

AIRCRAFT VALVES and FITTINGS

To Air Corps, AN and Navy Specifications

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Here they come — the **CURTISS-COMMANDOS!**

"Swarming down from the skies, Allied gliders and parachute troops captured enemy airfields . . ." More and more in the day's news, words such as these reveal the vital part that transport and cargo planes are playing in the swift invasion of enemy-held areas.

The Curtiss-Commando, the world's largest twin-engined transport, has a leading role in this new and revolutionary phase of the war. These giants of the air telescope weeks into hours and perform prodigies in swift movements of men and materiel.



SECOND PRINTING! Send 10¢ for your copy of this fascinating 76 page history of aviation. By Assen Jordanoff, author of "Your Wings" with illustrations of current fighting types. Airplane Division, Dept. M, Curtiss-Wright Corporation, Buffalo, N. Y.

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Corporation
AIRPLANE DIVISION

FIRST
Since the Birth of Aviation



1920 • Curtiss Eagle, first inter-



1928 • Curtiss B-2 Condor Bomber for the U. S. Army. Greatest weight carrying airplane of its time. Heavy de-



1929 Curtiss Condor, 2 pilots and 18 passengers, 150 m. p. h.



1933 • Curtiss Condor, the first sleeper plane—6 compartments, each with 2 berths, two 720 h. p.



Airacobras Being Prepared for Combat

MEET Joe Brown, A. M.

Expertly concealed from view, this distant Allied Air Base is on the alert for enemy bombers. With orderly dispatch the ground crew readies an Airacobra for its vital performance in action.

What qualifies these men to so guard the lives of pilots? Meet Joe Brown. Aviation Mechanic of the ground crew.

Joe signed up after having a little mechanical experience. Because he was alert and willing to learn the Army sent him to our training school after preliminary aircraft training.

Here, like thousands of other boys who have also attended our school, Joe learned almost everything there is to know about a P-39 Army Airacobra from design and construction to the most minute detailed service operations. His training under Bell technicians was part of a carefully developed program which is making a solid contribution to America's success in sky combat.



Now on a distant front, his is an assignment of which any man might well be proud. None is of greater importance. Mastery of the air depends not only upon planes and pilots but also upon the thoroughness and competence with which the planes are serviced by the ground crew.

We have not forgotten Joe and his fellow Army A.M.'s. Many of our own highly trained men are working with them on distant fronts, solving problems of service that no laboratory tests can answer.

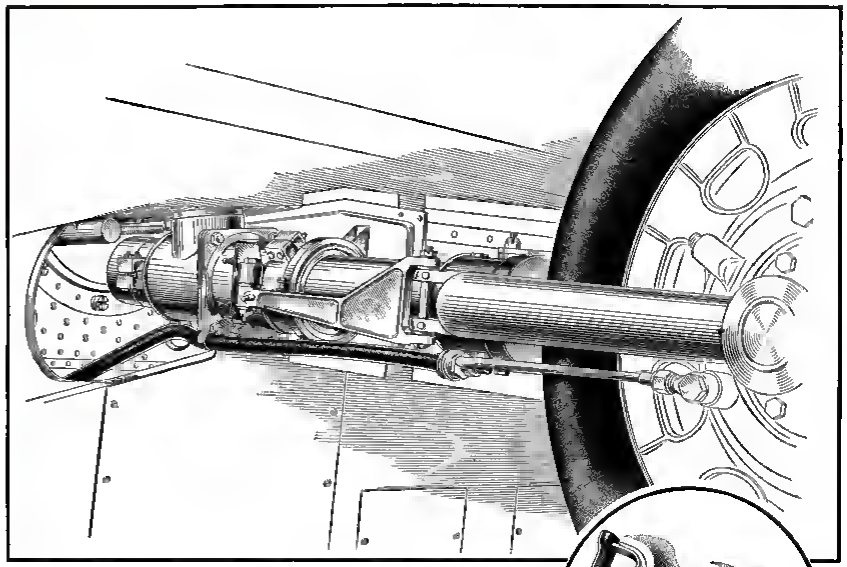
In this way, we are learning many vital things about improving aircraft for a world at war. And we also are learning many things that will be of tremendous benefit in building still better planes for a world at peace. © Bell Aircraft Corporation, Buffalo, New York.

Airacobras for victory—

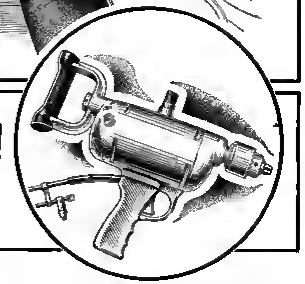
FUTURE PLANES FOR PEACE

BELL *Aircraft*

PACEMAKER OF AVIATION PROGRESS



what the Landing Gear Learned from the Portable Drill



IT'S A LONG WAY from portable tools to fighter planes—but an idea that works in one often proves just as good in the other.

That's the way it was with the Torrington Needle Bearing. Portable tool builders quickly saw how its unusual features could be used to cut excess ounces out of their product designs—where *every* ounce counts in conserving the operator's energy, in increasing his efficiency.

These same weight-saving features also caught the attention of the airplane designers. When they needed a bearing that would give easy operation to retractable landing gears—stand up under the terrific impact when three tons of fighter plane hits the runway—and still meet the rigid weight requirements of fast, maneuverable aircraft, they found just what they wanted in the Needle Bearing's unique combination of low friction coefficient, high load capacity, and small size—plus its ready availability for war applications. That question of size is doubly important when it comes to weight economies. It means light weight in the bearing itself, of course. But much more important is the fact that housings and other parts can also be made smaller and lighter.

ISN'T THERE AN IDEA HERE FOR YOU TOO, as you get your post-war designs under way? This light weight trend looks increasingly important, with freight-by-air looming up as the coming means of shipment. While you're studying ways to conserve weight in *your* products, see how well the Needle Bearing fits into your problem. You will find the preliminary information you want in Catalog No. 114—and Torrington engineers will help you in adapting the Needle Bearing to specific applications.

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New York Boston Philadelphia Detroit
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TORRINGTON NEEDLE BEARINGS

KEYED TO TODAY'S NEEDS

AND TOMORROW'S TRENDS



The Sunnen Precision Honing Machine will help you to

CONSERVE
VITAL WAR MATERIALS



The coveted Army-Navy "E" waves over the Sunnen plant—evidence of the important part Sunnen equipment is playing in the war effort.

★ The greater accuracy of the Sunnen Precision Honing Machine assures fewer rejects—conserving not only vital war materials but precious man-hours of labor as well.

Since the Sunnen Precision Honing Machine is usually used to perform the last operation, its super-smooth finish and accuracy make possible absolute interchangeability of parts—another time and money saving feature.

Consider These War Production Advantages!

Skilled labor is not necessary! Operators, even girls in 'teens, can be trained in a few hours to handle jobs in "tenths."

The Sunnen Precision Honing Machine is low in cost—economical to operate.

Relieves big internal grinders for other important jobs.

Wide range—handles internal cylindrical surfaces from .185" to 2.400" in diameter. No jigs or fixtures—work is held in hands.

Accuracy within .0001" guaranteed.

Put Sunnen Honing to work in your plant!

Write for complete information—or we'll gladly have a Sunnen engineer call and show you what the Sunnen Precision Honing Machine can do on your job in your plant.

SUNNEN PRODUCTS CO., 1942 Menchester Ave., St. Louis, Mo.
Canadian Factory: Chatham, Ontario

SUNNEN



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Aircraft Valve Tappet Roller. "4 Micro finish."

Drill Jig Bushing. "Increases sales appeal of product."

Bronze Valve. The Sunnen method of honing is used to secure a high finish and accuracy.

Inner Bearing Ring. "Accurately removes last 'tenth' of stock."

Aluminum Aircraft Unit. "Produces high finish without bell-mouthing."

Drawing and Blanking Die. "Saves time in producing smooth bore metal finish."

"Strict alignment maintained between two holes."

Aviation Hydraulic Cylinder made of Aluminum-Alloy. "Improves the quality of the bearing surface. An extremely smooth surface-finish is secured."

Saved time in producing a smooth, accurate finish on this bronze remote control valve body.

Cones for Wheel Balancing Machine. "Accurately align bores two interrupted surfaces."



An Answer from the skies

"NO FOREIGN power can ever harm Germany from the air" was the boast of Hitler's air marshal. Yet today American planes, piloted by American airmen, are flying far into middle Europe, carrying loads of destruction to the mighty industrial plants—the huge utility system—the network of transportation lines that are all so vital to the Third Reich's military power.

This sky borne answer to Goering's boast is dramatic proof of the quality of American planes—and the American engines that power them.

For as the size of these planes and the size of the loads they must carry have gone up—and up—and up—the engines that power them have kept pace. Today, motors of 2000 hp and over are an accepted fact with engineers looking forward to greater and greater horsepower in the motors of tomorrow.

What this increased horsepower means to the gears that transmit engine revolutions to the whirling propellers can well be imagined.

For aircraft gears must be light in weight, yet the slightest inaccuracy in gears revolving at such high speeds transmitting such great horsepower would quickly spell failure. No wonder aircraft engineers long considered such high precision gears a laboratory product.

But an air armada of the magnitude we are launching demanded that gears be produced by the hundreds of thousands.

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WHY THE *Axis can't win* THIS SCRAP WE'RE IN



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Another good reason why the Axis won't win is this giant Douglas C-54. Inside its four Pratt & Whitney Twin Wasp Engines, 5400 horses and antifriction bearings make sure that men and materials move fast to where they're needed most. As SKF's were used on vital airplane engine positions in Peacetime, so are they doing their part today. 5192

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Power—Giant Arm of Production

Ninety Per Cent of American Industry Is Electrified

ELECTRICITY is the mainspring that turns the wheels of our factories, mills and mines. It is the tireless arm that grinds our grain, weaves our cloth, pumps our water, builds our planes, our guns, our ships, our cars, our trucks and tanks . . .

The mighty Pharaohs had less energy at their disposal in building their pyramids than is generated today by one single power plant. The combined capacity of America's central power systems is without parallel in the history of the world. 46 million kilowatts, i.e., 65 million horsepower in steam turbines, hydro turbines and other prime movers. That is more power, day in and day out, than 650 million slaves could produce—for a limited time—minutes in fact.

The capacity of this vast fountain of energy is beyond the grasp of the average man who flips a switch and sets in motion machines that perform the labor of a thousand man hours in a matter of minutes. Perhaps only the old time farmer, whose traditional source of power is a team of tired horses and a pair of calloused hands knows how to appreciate this commodity that is so vital an ingredient of everything we consume and use.

This is the seventh of a series of editorials appearing monthly in all McGraw-Hill publications, reaching more than one and one-half million readers, and in daily newspapers in New York, Chicago and Washington, D. C. They are dedicated to the purpose of telling the part that each industry is playing in the war effort and of informing the public on the magnificent war-production accomplishments of America's industries.

Yes, we take electricity for granted. We expect it to appear in unlimited quantities, like water and air, as we need it. Almost as essential as these two elements in times of peace, it becomes a matter of life and death in times of war. Industry would collapse without it and the nation would quickly perish.

With the catastrophe of Pearl Harbor a little over a year ago, came the realization that we had to outproduce our enemies. To outproduce our enemies, who had a seven year head start, meant to turn more wheels than they were turning and to turn them faster than they were turning them.

New plants sprung up overnight. Production increased beyond our wildest dreams. Aircraft and shipbuilding surpassed the most daring forecasts. The machine tool industry's output grew to a volume that bordered on the miraculous. Guns, shells, uniforms, shoes, tanks and a thousand other items were being made in hitherto undreamed of quantities. All of them have one common essential ingredient—power. Industry demanded power—more and more power!

It is no small tribute to the power industry that, while other raw materials developed shortages necessitating strict priorities control, electricity remains unrationed—no priorities, no curtailments, no rate increase. Current industrial consumption is running 16 per cent over 1941 and 50 per cent over 1940. Not spectacular perhaps but when we consider that the nation's 26 million domestic consumers utilize only about 14 per cent of the energy output, we begin to get some idea of industry's power consumption.

Our power companies might have been stunned by the prospect of mounting demands for kilowatts. Instead they set about developing and coordinating a multiplicity of relatively small and seemingly unrelated factors. Individually or even collectively, these have not been of a spectacular nature. Certainly they have not inspired the award of the Army-Navy E although they are an essential ingredient in every Army-Navy E that has been awarded to American industry.

The contribution of the power industry to the winning of the war is not likely to flame forth in newspaper headlines. It takes the more prosaic turn of portraying an industry that is doing wonders quietly, unobtrusively.

At the close of the last war the power at the disposal of the American industrial worker averaged 3½ horsepower. At the beginning of this war, twenty years later,

it had increased to 6½ horsepower What other nation can even approach that figure? This large provision of power is the achievement of the electric utility industry. For years it had built and applied its equipment to the highest standards of performance and operated its systems to equally high standards of service and dependability Always recognizing that "public service is a public trust" it had maintained wide margins of security in performance Today these margins are the source of the power industry's ability to rise to the emergency

In short, the electric utilities were prepared!

Power men are accustomed to looking ahead, to prepare for growing loads and allow for unforeseen contingencies, for electricity cannot be stored It is 'ordered" by touching a switch It is delivered and consumed at the same moment.

Months before the actual outbreak of hostilities foresighted power men set to work computing how much life of equipment could be risked in the process of crowding it toward greater output Generators, boilers, turbines, cables, transformers and even conductors underwent close scrutiny in an effort to increase the load — *safely* They figured, they experimented, they tried untried measures

Insulation, for example, is the crux — the least known component of electrical apparatus When it lets go the service suffers. It is not easy to know how near any bit of crucial insulation is to letting go It takes courage to work it to a point just short of failure . . . but that is exactly what is being done today

Technological forcing of equipment, however, is not all of the story Obsolescent equipment has been rehabilitated, salvage has been intensified, critical metals have been replaced by non-critical materials, water sprays, air blowers and other cooling methods have been installed to keep overloaded apparatus from overheating Nothing has been overlooked Ingenuity has contrived the well nigh impossible.

Hand in hand with these measures of expediency have gone measures of intensification. Hydrogen pressure for cooling generators has been stepped up from ounces to pounds taking more heat away from the machines and enabling them to carry greater loads Capacitors — little more than aluminum foil interleaved with thin paper — have been applied by the carload relieving the systems of that mysterious reactive current which is associated with that equally mysterious power factor. They have performed wonders in avoiding the need for additional generating and transforming equipment The use of portable sub stations has averted the otherwise necessary reserve capacity in fixed installations at many points.

When coal was placed on the urgent list last spring the electric utilities outstripped all other industries in providing storage for the winter Stocks on hand the first of October were sufficient for 105 days, or more than twice what would be considered adequate in times of peace.

When staff losses to the armed forces became serious power companies contrived measures that enable them to get along without aggravating the national manpower situation by hiring others to replace them Today meters are being read every two or three months instead of monthly, women are being trained to do drafting keep the logs in power plants and sub-stations and to test meters in shops and laboratories

On the summit of "Grandpa's Knob", a mountain overlooking Rutland, Vermont, stands a giant wind mill that would have been the delight of Don Quixote Towering 200 feet above the tree tops its mighty 175 foot propeller turns with the wind and drives a 1,000 kilowatt generator which feeds its output into the Central Vermont Public Service Corporation's power system The most ambitious wind turbine generator in the world, and a daring experiment of forward looking men

Today everything electrical is being tried, is being worked harder than it has ever been worked before

Great credit is due the men behind the electric power industry These men have recognized the responsibility of their jobs — it is a part of their very being Theirs is the kind of service that must be maintained No soldier is truer to his trust than is the employee of this great industry

The service must go on! No matter what happens — acts of God or deeds of men — the service must go on! Labor disturbances may disrupt other industries but there have been no shutdowns due to labor trouble in electric power plants since Pearl Harbor.

And this winter when blizzards pile up drifts and sleet makes pavements slippery there may be absenteeism from other plants but the utility employees will be on the job ready to climb the ice-covered poles and repair the ice laden lines whenever the call comes.

In this war the least costly yet the most precious element of production — electricity — will be ever ready to "man" the machines that will produce the weapons that will give victory to the forces of freedom.

James H. McGraw, Jr.

President, McGraw Hill Publishing Company, Inc.

Our Airlines Will Serve Better As Private Enterprises

LONG BEFORE THE WAR was thrust upon us, our defense program was implemented by the most highly developed air transport system in the world. Our domestic airlines cheerfully gave up their equipment when it was needed by our allies Maintenance methods were developed to keep the remaining planes aloft for longer periods Schedules were maintained with negligible impairment of service. When the armed forces were in need of special air transport facilities, equipment and personnel were loaned by the airlines to perform the missions. And now almost all of the larger domestic airlines are preparing to operate over the Atlantic and Pacific Oceans and any other places where they may contribute to the war effort.

Even more spectacular were the accomplishments of the foreign-extension airlines of the United States. Bases were built in the jungles, in the deserts of Africa, and in the capricious climates of Alaska where temperatures vary as much as 100 deg in a single hour of flight. Transoceanic ferry services were set up and operated on an incredible scale The full story of the contribution of our airlines to the war effort must not be told until the war ends, but a glance at a world map will show how important these services are in the transport of passengers and cargo to the war fronts and in the return of scarce and vital war materials from the remote corners of the earth

Practically all of these major accomplishments were performed under civil ownership and operation of the airlines, with top priorities provided for the needs of our armed forces Our Army and Navy had at their immediate disposal the finest air transport operating organization in the world. And the armed forces were free to use this valuable tool without assuming responsibility for its operation

THIS HIGHLY EFFECTIVE RELATIONSHIP IS NOW threatened by militarization. Already, some of the foreign extensions have been taken over by the Army. There is danger that the militarization will spread to other foreign operations—and even to the domestic lines.

Chief objections to militarization of air transport operations is that it accomplishes nothing that could not be accomplished better without it The demoralization of flight personnel placed in uniform at lower pay is not as serious as it might seem because many pilots are reserve officers and are anxious for active duty But the real danger lies in the complex procedure, characteristic of the armed forces, which frequently takes these men out of the cockpit for other assignments and seriously impairs the organization of which they were a part

Even more serious is the effect of militarization on the ground organizations. It is improbable that the highly efficient maintenance and servicing organizations that have been built up and developed to increase the daily flying hours of our equipment can be retained under military operations It has been an herculean task to keep our maintenance organizations together in the face of competition by the attractive wages offered to aviation mechanics by manufacturers. And these organizations are the true basis of the incredible regularity and intensity of our airline operations

AND LAST BUT NOT LEAST we must consider the position of our airlines in the postwar period. British Overseas Airways is operating as a private enterprise across the Atlantic and in many other places Although they have always been close to their governments, the German Lufthansa and the Japanese airlines are still operating on approximately the same basis in spite of the war

Militarization of our airlines imposes a serious and unnecessary responsibility on our armed forces, which at this time have many other things to do The inevitable disorganization of our civil operating organizations would place us at a serious disadvantage in the competition for world trade that will follow the war

Leslie E. Neville

AVIATION'S
WAR COMMUNIQUE
NO. 13

America at War

First month of our second war year finds the United States throwing ever increasing weight against the Axis in the air, on the ground, and on the sea. American air power today presses the dictators on many fronts.

TWENTY-ONE YEARS AGO, a twin-engine Martin MB-2 biplane bomber, capable of carrying one 2,000-lb bomb in a closed bomb bay, sank an obsolete American destroyer, the G-102; the old battleship *Alabama;* the captured German battleship *Ostfriesland;* and the captured German cruiser *Frankfurt*. All were mortally hit, while under way, in the demonstration of air power vs. surface ships, conducted by Gen. Billy Mitchell in his effort to convince the Army it should embark upon a strong aviation program.

A year and a month ago, a Japanese ship-borne air mission took the Hawaiian garrisons by surprise and put out of action half the capital ship force of the United States Navy, plus eleven other war vessels and more than half of a force of nearly 500 Army and Navy airplanes.

Though not the biggest, it was the most decisive naval victory in modern history, for it cost the enemy but 48 relatively cheap airplanes and three vest pocket submarines. As the Navy itself has said, the Japanese victory laid our Hawaiian Gibraltar wide open to capture, in which case many more thousands of American lives and billions of dollars might have been sacrificed before the inevitable defeat of the sons of the rising sun.

Now, 13 months later, we have—thanks to the technological prowess of the country recovered all that was lost and more, in a space of time even more miraculous than the 30-min. blasting by the Mikado's minions. That a second front could be opened within a year is due to that technological prowess.

And that prowess, both on the ground and in the air, will make it increasingly tough for Hitler, Goering, Goebbels & Co., the boys who were always going to dish it out a thousand for one. For they are already within a three-sided air squeeze from England, Russia and Africa.

Germany has the advantage of the inside position with shorter lines of communication and supply, but the Allied nations already are outproducing the Axis by a constantly growing margin. Great Britain is producing almost, if not as many, planes as Germany. It is possible this country can send to the European theater alone as many planes as Germany can produce. Meanwhile, Russia's capacity is one of the war's best kept secrets, but it is possible they, too, can come near equalling the Nazi output.

Odds against Hitler grow more and more staggering, a fact which Hitler must know well. Germany's power is small compared with that of all the nations arrayed against her. The threat which worked so well for a time comprised long preparation plus a belligerent disposition.

Churchill, nearly always a trustworthy source of information (though he once said that Singapore would stand) for the first time in this war says that Hitler's air power is on the wane. He says the Luftwaffe is not receiving full replacements for its losses and that the quality is perhaps not up to Nazi standards. It is a question now whether Hitler can withstand an Allied force crossing the English Channel at the same time another crosses the Mediterranean and while angry Russians dive at him from behind. These Nazi bad boys of the air, who attacked refugees along the roads of Europe, blowing banshees on their Stukas, are now by way of taking their "thousand fold" going the other way.

(*Turn to page* 309)

International News Photo



This will become an increasingly familiar bombardier's view as other Consolidated B-24 "Liberators," together with their American and Allied heavy bomber teammates, raise the pressure on the Axis striking from three sides.



Above: Bombing this year reaches maturity from the standpoint of age as well as military effectiveness, for it was 21 yr. ago that this Martin MB-2, with 2,000-lb. capacity, sank two battleships, a cruiser, and a destroyer in the still discussed Gen. Billy Mitchell demonstration.

Below: Two more Jap bombers put out of action by growing United States power. One, in the distance, is just bursting into flames, the other is diving into the sea. Fact that the United States was able to take the offensive before the beginning of this second year of war is a tribute to its productive genius.

Official U. S. Navy & International News Photo



Miracle of 1942

America's first year of war saw our industry turn in a record-shattering War-With-Wings production performance that rea Axis Plaeamakers into the ground. Our manufacturers fochiad "whot aouida't be done" and did it—and made aviation the oatioa's leadiag iadustry.

PRINT IT BOLDLY IN THE RECORD—America's aviation industry performed the impossible in 1942. In the wake of the crippling crisis of Pearl Harbor, it set out to do "what couldn't be done"—set out to do it *and did it*.

That the industry's achievement was history-making is evident. For while the world ledger down the centuries has been full of piercing problems posed by baffling crises, rare have been the instances when they have been solved in the "manner of miracles." This, certainly, was one of those rarest of instances. Call our industry's striking accomplishment the "Miracle of 1942."

Let us trace that War-With-Wings record.

Total plane production for 1942 was 49,000—nearly a 150-percent "up" over '41's 20,000 warcraft. It was an average output per month equal, virtually, to the yearly rate recorded but 19 months ago when in May of 1940 the President set a goal of 50,000 planes. And as for those 50,000 planes, the country got them in "53 weeks of '42" rather than in 1944 as prewar estimates foresaw.

Not that this miracle was all lift and no drag. Far from it. Criticism? Surely, there was plenty of that. Obstacles? Innumerable ones big and little, but mostly big. Yet despite them all, the industry went from a rate of 2,000 planes per month on that fateful Dec. 7 to better than 5,500 at '42's close, built more planes in these preceding twelve months than in the 23 years prior to the war.

Additional facts and figures emphasize the story.

Dollar volume of output of airframes, engines, and propellers zoomed from $1,750,000,000 in 1941 to an amazing $4,500,000,000 in 1942, making aviation America's biggest industry.

While Pearl Harbor found 41 companies operating 59 plants, by the end of 1942 there were 64 companies operating more than 100 plants—a 70 percent rise which brought with it a boost of better than 75 percent in floor space.

The year saw plant personnel in a meaningful 130 percent increase, giving us a total army of workers surpassing 1,500,000. Meanwhile, women bulwarked the factory ranks, their numbers multiplying from 4,300 in January to a weighty 115,000 in December.

Again to units. Tonnage of planes—augmented by a several hundred percent increase in bombers—went up 300 percent. And it may be pointed out that had not strategy called for an expanded bomber program, total unit production of aircraft easily would have soared far above that incredible record, which was achieved.

Throughout, engine horsepower paced the race. Hardly yesterday, it seems, the words "engine" and "bottleneck" were too close to the synonymous for comfort. By ratio, fractionally more than two powerplants were needed per plane. But this industrial fight was joined with spirit, and by the year's end, output of engine horsepower had risen a solid 240 percent.

Remember, these warcraft had to be built for the widely varying climatic framework of the world, not just of America. They had to be efficient for operation over steaming jungles, burning sands, frigid snow fields. Constant alterations—to meet stringent service conditions, or, in the course of improvement in designs, to surpass enemy plane performance—had to be made as the production lines rolled, without reduction of schedules. Through development of multi-purpose equipment, flexible tools, new parts and raw materials these problems were met in 1942, often with "right on the spot" ingenuity.

The picture is one of Axis-smashing teamwork extending, in powerful array, from the primary "backbone" companies of the business through staunch ranks of subcontractors and sub-subcontractors producing assemblies, subassemblies, and sub subassemblies. In 1941, the President had called for "the stream to become a river, and the river a torrent to engulf this totalitarian tyranny which seeks to dominate the world." This was that torrent.

That the q's of quality as well as the p's of production were minded in this great performance was evidenced on the far-flung fronts. The combination of our aircraft's fire power, armor, engine power, equipment, and range was the opening premise of 1942, and the box scores of enemy planes destroyed was the conclusion. Effectiveness of our planes was mirrored in the ratios of planes downed, which grew from 2 to 1 in February to 14 to 1 in our favor in October.

Throughout the year, Yank airmen in those planes "gave it" to the Japs. During the year's second half, our strikingly efficient bombers "poured it" to the Nazis on the Continent. Then, in November, came the prime test—the invasion of North Africa.

The Germans and their superb machinery of war had been carefully noted by the local French and Arabs. The impression had been deep. But decidedly more impressive were the Americans, particularly their material. The cry heard everywhere as our warplanes hurtled into action was "*Quel equipment!* The Boche will be on the run!"

Fitting deeds to these words, our warcraft were busy softening up the last African strongholds of said Boche as the year closed. And at home, more scores of our aviation companies ran up "E" flags tokening the fact that those punches, battering the Axis in all corners of the globe, were being delivered *direct from the factory*.

Meanwhile, our AAF, now with more than a million officers and men (and two million looked for by the end of '43) is getting vastly improved craft—fighters and bombers with increased fire power, speed, bomb loads, maneuverability, ceilings. These warplanes, promises Gen. Arnold, will readily outclass our present equipment . . . our B-17's and B-24's will seem small . . . our present combat-plane weapons will seem "like pea shooters."

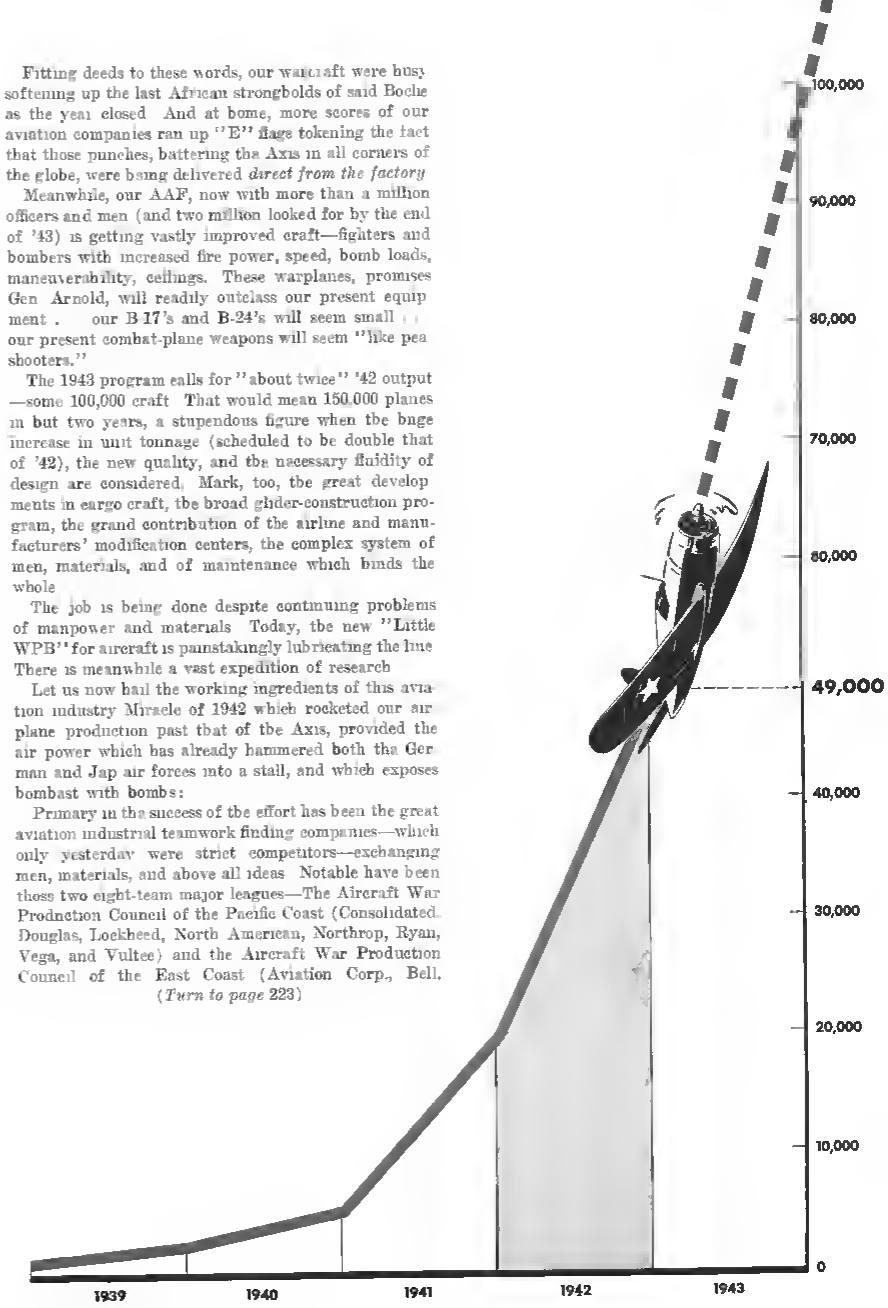
The 1943 program calls for "about twice" '42 output—some 100,000 craft. That would mean 150,000 planes in but two years, a stupendous figure when the huge increase in unit tonnage (scheduled to be double that of '42), the new quality, and the necessary fluidity of design are considered. Mark, too, the great developments in cargo craft, the broad glider-construction program, the grand contribution of the airline and manufacturers' modification centers, the complex system of men, materials, and of maintenance which binds the whole.

The job is being done despite continuing problems of manpower and materials. Today, the new "Little WPB" for aircraft is painstakingly lubricating the line. There is meanwhile a vast expedition of research.

Let us now hail the working ingredients of this aviation industry Miracle of 1942 which rocketed our airplane production past that of the Axis, provided the air power which has already hammered both the German and Jap air forces into a stall, and which exposes bombast with bombs:

Primary in the success of the effort has been the great aviation industrial teamwork finding companies—which only yesterday were strict competitors—exchanging men, materials, and above all ideas. Notable have been those two eight-team major leagues—The Aircraft War Production Council of the Pacific Coast (Consolidated, Douglas, Lockheed, North American, Northrop, Ryan, Vega, and Vultee) and the Aircraft War Production Council of the East Coast (Aviation Corp., Bell,

(*Turn to page* 223)





Technique to Shorten Takeoffs and Landings

By R. deH. WILLIAMS
Test Pilot, Boeing Aircraft Company

Today, pilots all over the globe face hazards of flying into and out of all manner of makeshift fields—hence ability to make minimum ground runs is now a "must." Through analysis of the key factors, this practical study enables the pilot to effect these vital short runs with any given airplane.

FREQUENTLY DISCUSSED among pilots is this question: How should a plane be handled in order to effect the shortest possible takeoff or landing? The following study was made to solve this problem, assuming a conventional type of airplane, equipped with brakes, as the basis for the investigation.

Several approximations were made in the interest of keeping the mathematics involved in the derivation of the equations as simple as possible. One such approximation is the consideration of μ (the ground friction coefficient) as a constant throughout the roll. However, any error introduced by this consideration is believed to be small, because the μ values used in the accompanying Table of Surface Coefficients were taken from experimental data and represent average values which will give satisfactory results.

Another approximation was the omission of the wheel inertia forces from both landing and takeoff equations. These inertia forces, and other minor forces and moments, may be neglected because they will tend to cancel out when the equations for tail-high and tail-low ground runs are compared. Therefore, it is safe to conclude that any error involved in the computations of μ_{CB} and μ'_{CB} is negligible.

Takeoff Attitude for Minimum Roll

First case to be considered is that for a takeoff in tail high attitude at zero lift. The forces assumed to be acting during all takeoffs are inertia force, rolling friction, air drag, and thrust.

The summation of these forces in the X direction yields:

$$1 \quad \Sigma F_X = Ma = T - (\mu W + C_{DP} Sq) = 0$$

And solving this equation for "unstick" distance:

$$2 \quad \frac{W}{g} V \frac{dV}{dX} = T - (\mu W + C_{DP} Sq)$$

$$3 \quad X = \int_{\cdot}^{V_T} \frac{WV\,dV}{g[T - (\mu W + C_{DP} Sq)]}$$

The second case is based on a takeoff run made in the tail-down attitude. Lift will reduce the rolling drag in direct proportion to the amount of lift, thus: $F_f = \mu(W - C_L Sq)$. Lift will also increase the air drag by the addition of induced drag, and the air drag equation now becomes: $F_a = C_D Sq$. Summation of the acting forces is now expressed:

$$4 \quad \Sigma F_a = Ma = T - [\mu(W - C_L Sq) + C_D Sq] = 0$$

And solving for "unstick" distance:

$$5 \quad \frac{W}{g} V \frac{dV}{dX} = T - [\mu(W - C_L Sq) + C_D Sq]$$

$$6 \quad X = \int_{\cdot}^{V_T} \frac{WV\,dV}{g[T - \mu(W - C_L Sq) + C_D Sq]}$$

Examination of equations 3 and 6 will reveal that as the quantity $(\mu W + C_{DP} Sq)$ in equation 3 and $[\mu(W - C_L Sq) + C_D Sq]$ in equation 6 becomes larger, the takeoff distance will increase. Since C_L is always greater than C_{DP} when the wing is lifting, the only instance where equation 6 will yield a shorter takeoff distance than equation 3 is when the coefficient of rolling friction is quite high, as in the case of muddy or rough fields. (See our Table for representative values of μ for various surfaces.)

It may be proven that the quantity $(\mu W + C_{DP} Sq)$ and $[\mu W - C_L Sq) + C_D Sq]$ determine the value of the integrals and that they may be compared directly, or equated, to find the critical value of μ_{CB} if the dividend in the integral is always positive.

In order to find the critical value of μ_{CB} at which it would be advantageous to takeoff in full tail-down attitude, equation 3 may be set equal to equation 6 and solved for μ_{CB}. That is—

$$7 \quad C_{DP} Sq + \mu W = C_D Sq + \mu W - \mu C_L Sq$$

$$8 \quad C_{DP} = C_D - \mu C_L$$

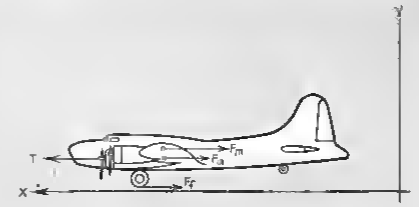
$$9 \quad \mu_{CB} = \frac{C_D - C_{DP}}{C_L}$$

It is obvious that an optimum value of C_L (attitude of airplane) would exist for every unique value of surface coefficient. This range of optimum C_L

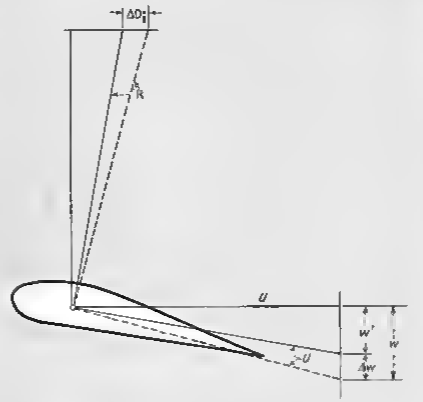
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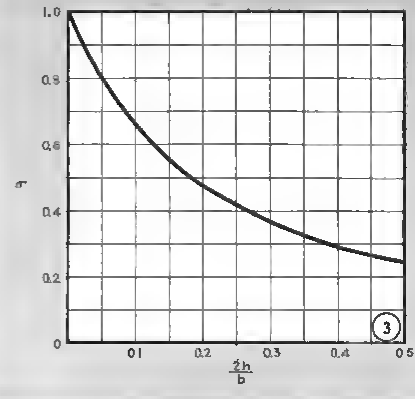
SYMBOLS

- μ = Ground friction coefficient
- μ' = Braking friction coefficient
- μ_{CB} = Critical ground friction coefficient
- μ'_{CB} = Critical braking friction coefficient
- W = Gross weight
- g = Acceleration of gravity
- T = Thrust
- C_{DP} = Parasite drag coefficient
- S = Wing area
- q = Dynamic pressure
- X = Ground distance
- C_D = Total drag coefficient
- C_L = Lift coefficient
- V_T = Takeoff speed
- V_L = Landing speed
- D_i = Induced drag
- σ = Interference coefficient
- $F_m = \frac{W}{g} a$
- Fa = $C_{DP} Sq$ for zero lift and $C_D Sq$ for positive lift
- $F_f = \mu(W - C_L Sq)$
- C_{LT} = Takeoff lift coefficient
- C_{LL} = Landing lift coefficient
- b = Wing span
- h = Height above ground
- AR_e = Effective aspect ratio

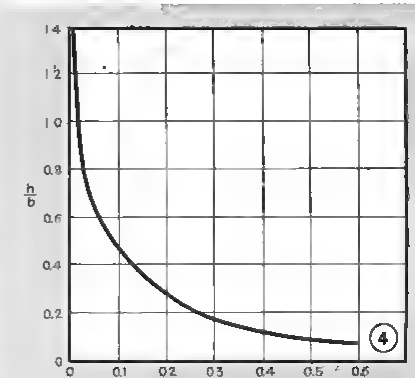


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4

Investment Status Of the Aircraft Industry

Uncertainty over contract renegotiations and the postwar outlook is confusing the earnings picture for aircraft equities—but definite confidence is felt in future earnings of sound aircraft companies.

CONSIDERABLE APPREHENSION exists in the minds of the investment fraternity as to the future outlook of the aircraft industry.

The American invasion of Africa, at the onset, seemed to convince many investors and speculators that it may be well to sell aircraft and other equities having a war flavor. More somber reasoning that the war will not be over next Tuesday lessened the liquidation in these issues.

Here again is another indication that the aircraft group is viewed solely as a war industry with but limited utility in a peace-time economy. This is no new revelation, for market trends have chronicled this reasoning for some time. For example, the accompanying Barron's averages show that aircraft stocks, as a group, have declined more than 20 percent from last year, while the general averages have remained about the same. By contrast, the air transport group is now slightly higher than a year ago.

There is no denying that it is unlikely that the huge military demands for aircraft may exist in the same measure during an era of peace. This factor has been generally discounted. The future market for aircraft production is subject to much conjecture, and considerable speculation has been advanced in measuring this potential demand.

Much of the uncertainty revolving around the future outlook of the aircrafts would be removed if more information were available as to the exact status of the individual companies. The annual reports of 1941—the last published data generally available—are without value in gaging the present position of the separate companies. It will be some months before 1942 annual reports will be released. At that time, many of the mysteries surrounding the financial condition of the group should be solved. However, some question marks may remain in view of the constant renegotiation process.

Indefinite conditions caused by renegotiation of contracts is highlighted by recent annual aircraft reports released by a few companies. For the fiscal year ended Sept. 30, 1942, Beech Aircraft Corp. reported a net profit, after all taxes and charges, of $2,417,819, or $6.04 per share on the 400,000 shares outstanding. A year earlier, net earnings were $471,715, or $1.17 per share. However, a footnote to this report calls attention to the fact that despite a provision of $7,200,000 for refunds to the government on renegotiation of war contracts, still further refunds may be in sight. The statement reads:

"Subsequent to Sept. 30, 1942, a proposal of downward adjustment of net income was tendered the company by representatives of War Department Price Adjustment Board, which proposal, as of Nov. 25, 1942, had been rejected by management of company. The effect of proposal, if accepted, would further reduce net income for fiscal year (before federal and state income taxes) by approximately $2,715,375. Net income indicated is therefore subjected to subsequent adjustment that may be consummated between company and government."

This important qualification places a serious question mark opposite the reported earnings of Beech Aircraft, since, if enforced, these new reductions will, after giving effect to tax adjustments, cut the indicated net earnings to shareholders in half.

Similarly, Cessna Aircraft Co., reporting for the fiscal year ended Sept. 30, 1942, shows a net profit of $738,202, or $2.11 per share. Incidentally, this is a material reduction from the $1,796,594 profit, or $5.13 per share, reported for the previous fiscal year. But here, too, the fine print calls attention to the provision already made for the refund of $4,800,000 on government contracts and the recommendation by a representative of the War Department Price Adjustment Board that an additional $1,850,000 be refunded. The company has rejected this new proposal, and further discussions appear in sight before any agreement will be reached.

It is a safe surmise that in both instances reported earnings will unquestionably be revised downwards.

In any event, final earnings for the calendar year 1942, representing the bulk of the industry, will be out in a few months and may show up much better than is popularly supposed. It will also be found that the effect of the tax bill, while severe, is not completely onerous. Our accompanying table of earnings indicates the estimates for a group of aircraft companies advanced by a leading statistical service. Of no small importance is the 10 percent postwar tax credit which will prove beneficial to the aircraft builders.

For some time, fear of taxes served to dampen investment enthusiasm for aircraft equities. Now that the tax phobia has been safely resolved (for the time being at least) something new has been added to cause concern to the investment observer viewing the aircraft group. This is the need for additional working capital. On close perusal, however, the aircraft people will not be hard pressed to meet their short-term requirements.

Fact that such industrial giants as General Motors deemed it necessary to arrange for a $1,000,000,000 line of credit was generally believed to indicate that the aircraft builders—already extended as to their working capital—would soon follow suit in arranging for short-term bank accommodations. This would, of course, be arranged through the simple expedient of Regulation V

(*Turn to page 309*)

EARNINGS FOR LEADING AIRCRAFTS

Actual for 1941 and Estimated for 1942

	Per Common Share		
	1941 Actual	Estimated 1942*	10% Tax Credit
Boeing	$5 65	$5 50	$2 15
Consolidated (a)	6 22	4 50	0 70
Curtiss-Wright	3 15	2 10	0 90
Douglas (a)	30 29	10 00	1 50
Grumman	2 10	2 40	0 90
Lockheed	6 89	7 50	2 80
Martin	5 24	4 75	1 60
North American (b)	1 77	2 70	0 10
Sperry	4 11	2 90	1 10
United Aircraft	9 81	4 25	1 50

* After various arbitrary adjustments for contract renegotiations

(a) For fiscal year ended Nov. 30

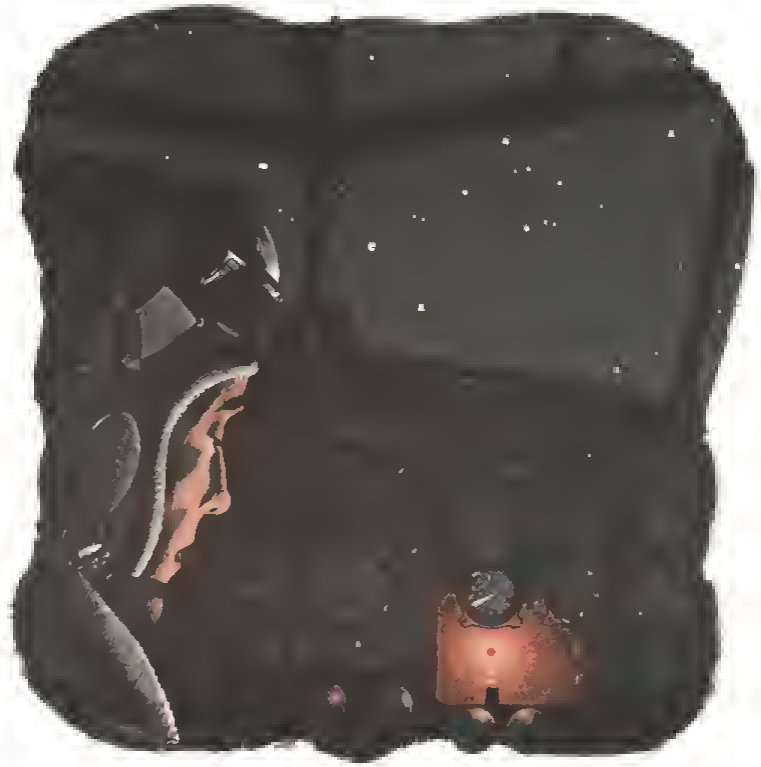
(b) For fiscal year ended Sept. 30.

Source: Standards and Poors

BARRON'S STOCK AVERAGES

	Aircraft	Air Transport	50 Stocks
Dec. 4 1942	27 25	*25 00	67
Nov. 27 1942	27 35	25 44	66
Nov. 20 1942	28 50	25 00	67
Nov. 1 1942	29 28	25 00	68
Nov. 6 1942	30 00	25 00	67
Dec. 5, 1941	35 12	24 75	65

* New High for 1942



"DANGER SPOTTERS"

A RED LIGHT winked out of the darkness! The pilot snapped to attention and checked his instruments for trouble . . . port engine fuel pressure dangerously low!

Instantly, he worked with the emergency hand wobble-pump, brought the pressure back to normal—and managed to keep it there until he reached destination.

The above incident, which actually happened over the mid-Atlantic on the ferry trip of a bomber bound for Britain, illustrates the importance of Pressure Warning Units to the pilot.

As you know, these little "danger spotters," weighing less than 6 ounces, free his eyes from constant instrument checking—for rest, for reconnaissance or combat operations . . . yet give instant warning of falling fuel or oil pressure in any engine before it becomes serious.

The Pressure Warning Unit is one of many devices and precision instruments which Kollsman makes for the Army and Navy, instruments that make our military aircraft safer and more efficient in flight.

Congratulations! Aviquip 10th Year

KOLLSMAN AIRCRAFT INSTRUMENTS Product of SQUARE D COMPANY

FLUSHING, NEW YORK • ELEVENTH, CALIF.

Fighting Snow To "Keep 'Em Flying"

By HAL W. HUNT
Assistant Editor, Engineering News-Record



Motor patrol grader with front mounted V-plow has the traction and power necessary to cut through the heaviest drifts. Wings are available for most machines of this type, and the regular underbody maintenance blade is useful for clearing packed snow and ice. Graders without the regular snowplow blades windrow snow ahead of the rotary plow

It's of utmost importance that airports be kept free of snow. Transport efficiency, so essential to the war effort, demands it. Airports must be usable at all times.

CLEARING OF SNOW from airports assumes unusual importance this year as many new fields face their first test of winter operation. Heretofore, under extreme conditions, flying could be suspended, but this winter the runways must be kept continuously open to be ready for offensive or defensive action and to keep the pilot training program in full operation. To assist in this essential part of the war effort, airport managers, airline officials, equipment manufacturers, and representatives of the United States and Canadian governments were questioned as to practices that they recommend for effective, economical and efficient snow removal. The results of this survey are presented here for such value as they may have in keeping military and civilian airports in service through this vital winter.

Briefly, the consensus is that the one desirable method of handling snow on airports is to get it off, and keep it off, the runways at all times. In places this is not practicable and other means are employed, but complete removal of the snow is always desirable, as the one safe landing area for an airplane is a clean and well defined runway.

• This article is taken from a report by Mr. Hunt published in the Nov. 5 issue of another McGraw-Hill publication — *Engineering News-Record*. It has been found that best practice to keep flying fields open is to get the snow off the runways and keep it off at all times. Plows, windrowing the snow, followed by rotary blowers to spread it without establishing banks, are generally preferred in handling airport snow. However, clearing with plows alone can be sufficiently effective.

There are several ways of removing snow from runways, varying in speed, efficiency, and cost, but most favored are machines that pick up the snow and deposit it well away from the used areas. This is usually done by plows, powered by high tractive effort trucks, working with rotary blowers or other snow throwing machines.

As a prelude to discussion of snow removal methods it should be stated that those familiar with snow handling are unanimous that the first requisite is adequate equipment. Some of this is special and expensive, but it is necessary for rapid and efficient snow removal from the huge areas at our main airports. Cost of equipment figured on an hours-used basis is exhorbitant; cost figured as a proportion of the value of an airport is very low priced insurance against having the investment quite useless for an indefinite period. In terms of aerial equipment, also, adequate snow handling machines are cheap. In peace time a single "washout" may cost as much in repairs and downtime as the snow machines necessary to avoid difficulties, and in time of war the value of always being able to get off the ground or land in an emergency cannot be estimated in dollars. The necessity and economy of complete snow removal is demonstrated by the fact that during last January and February at a Canadian training field 15 aircraft swerved off compacted runways. Damage amounted to as much as $150,000 on individual planes, with a total loss of $100,000. Officers at the field estimated that three-fourths of the damage would have been avoided if the runways had been cleared to provide a non-skid surface on which to land.



What it takes to clear an airport. High speed truck with one-way plow pushes snow to one side until windrow becomes large. Then heavier truck with wing takes over and finally a rotary unit is used to spread the snow eliminating banks. Vertical edges of banks, even outside the area of the runway, should be avoided to minimize trapping of blowing snow and damage to planes out of control



This machine works best against a windrow of snow, will turn large banks of snow piled up by other machines.

Snow-Moving Machines

A brief description of the snow-moving machines available will set the stage for the discussion of snow removal procedures covered herein.

First in point of simplicity and use is the one-way plow, mounted on a medium size truck and used to clear an area 6 to 8 ft. wide by throwing the

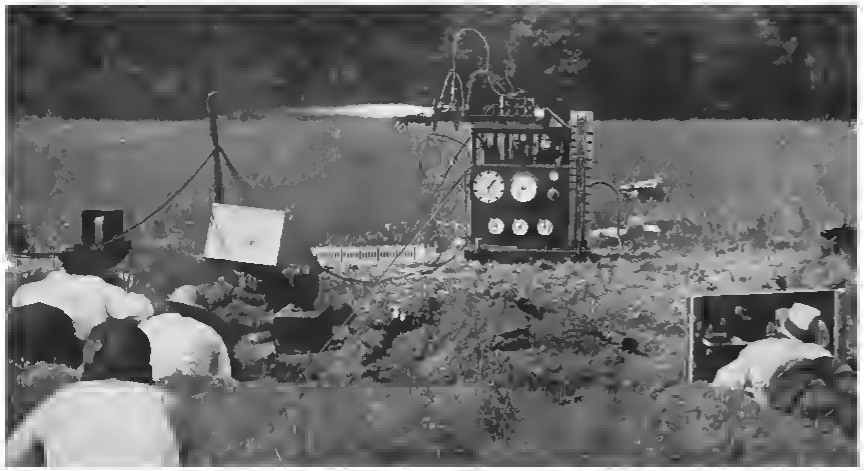
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This unit combines the advantages of plow and blower, will clear a swath 15 ft. wide and boost the snow off the end of the wing

Rocket Power for Assisted Takeoff

By ROY HEALY
President, American Rocket Society



Field test of a rocket motor. Photographic records are taken of test stand instrument panel. Operators and camera men are protected against possible explosion

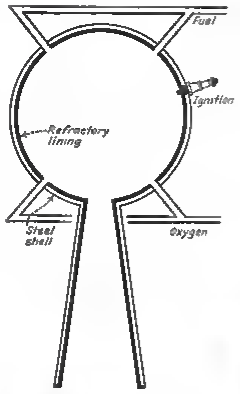


Diagram of a simple rocket motor for operation with liquid oxygen and fuel. Author believes that motors capable of 1,000 lb. thrust, with jet velocities considerably in excess of present figure of 6,500 ft. per second could be constructed to weigh not more than 25 lb.

Assistad takenff loams ever more expedient as a military necessity for bombing aircraft which most struggle to lift tremendoes loods of destraction for delivery to the enemy.

USE OF AUXILIARY POWER to aid the airplane into the air is not new—for the Wright brothers used a land catapult at Kittyhawk. It has long been recognized that takeoff assistance would be of great military value. A number of methods have been suggested and a few tested. But each method tried has had certain inherent disadvantages which militated against its acceptance.

With takeoff speeds constantly increasing, there has developed a corresponding increase in the length of runways, and consequently in the size of airports. Runways of two-mile lengths are now in use in this country and abroad. Unfortunately these make easy targets for enemy bombers, and if part of the runway is damaged the aircraft operating out of that field must reduce bomb load or fuel supply in order to

(*Turn to page* 221)



Rocket motor firing. Note shock waves in jet, evidence of extreme velocities.

Lockheed P-38 Has Wide Range of Tactical Uses



Kept well under wraps until after African invasion—in which it played a large part—Lockheed P-38 *Lightning*, it is now revealed, has been in action as a high altitude fighter, low level bomber, and photographic plane. With a top speed of "well over 400 mph" it lands at but 80 mph, the wide performance range being due largely to a new Lockheed Fowler flap which can be lowered in three seconds and raised in but four.

Details just released reveal it to be everything from bomber to high altitude fighter. Unusual Lockheed-Fowler flap aids maneuverability.

VERSATILITY appears to be one of the outstanding characteristics of the Lockheed P-38 *Lightning* twin-engine fighter. Details just revealed—after the plane had been in action for some time in the Aleutians, the South Pacific, Europe, and North Africa—show it has been used as both a low- and high-altitude fighter, as a dive bomber, and as a photographic ship.

Powered by two 1,150 hp Allison inline, liquid cooled turbo-supercharged engines, the P-38 has a ceiling above 40,000 ft. and a top speed of "well over 400 mph." Its 48 lb per sq. ft. wing loading is unusually high for a fighter craft.

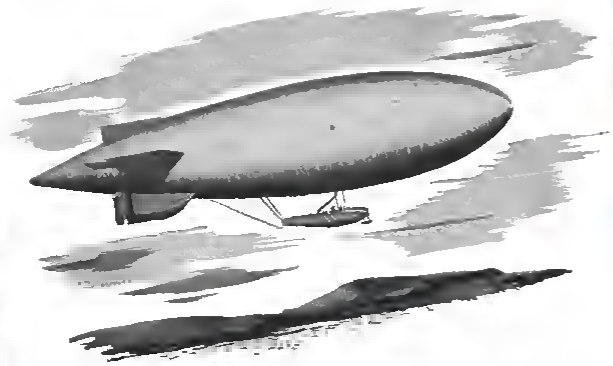
Landing speed, however, is but 80 mph, the unusual range of performance being attributed in large measure to a quick acting "maneuvering flap" which was developed by Lockheed and which has been in production for many months. An improved version of the Lockheed-Fowler flap, it can be extended into the down position in three seconds and raised in four. Use of the flap is not restricted to landings and takeoffs, for it is reported that the flap can be lowered during flight to increase maneuverability essential to successful combat work. Maneuverability is enhanced by the fact that the propellers rotate in opposite directions, thus eliminating torque.

The P-38 has an effective combat range of 750 mi., considerably higher than that of many modern fighter craft, due to jettisonable gas tanks of 150 gal. capacity. These tanks, designed by Lockheed engineers—who wind tunnel-tested 31 different types—have twice the capacity of earlier standard tanks, yet permit a 10 mph higher

(*Turn to page* 309)

Trail Blazing in the Skies

1917



THE FIRST SUCCESSFUL NON-RIGID AIRSHIP ever used by the United States Navy was built by Goodyear in 1917. Before the close of World War I a considerable fleet was in active service in anti-submarine patrol duty and proved highly effective. After the war Goodyear continued further to develop and improve airships by building and operating its own squadron.

1943



TODAY THE LARGEST NON-RIGID AIRSHIPS EVER BUILT are being produced by Goodyear for the Navy. Many are already in service along our coasts. These new ships have far greater range than their 1917 predecessors; carry a heavier bomb load and can stay aloft for days, if necessary. The ability to deliver these patrol ships rapidly and in quantity results from Goodyear's long pioneering in aeronautics.

HOW GOODYEAR AIRCRAFT CORPORATION SERVES THE AIRPLANE INDUSTRY

1. *By building parts to manufacturers' specifications*
2. *By designing parts for all types of planes*
3. *By re-engineering parts for mass production*
4. *By extending our research facilities to aid the solution of any design or construction problem.*

GOODYEAR
AIRCRAFT



AN ILLUSTRATION OF

Compact Design

The drawing shown here clearly illustrates how Timken Bearings applied to radial engine rocker arms conform to the aviation engine engineer's unwritten law of *compact design* for every part or group of parts in a plane's power plant Rocker arm bearing assemblies receive special attention since they are at the outside diameter of the engine.

Note that the Timken Rocker Arm Bearing is extremely compact, which helps keep the overall diameter of the engine, the distance between rocker arm and cylinder head and the distance between push rod and valve stem at a minimum. And yet, the Timken Bearing possesses sufficient capacity to withstand radial loads from valve spring tension and thrust loads set up by the angularity of the push rod.

Timken Bearings have been used continuously from the early days of the Wright Cyclone's history. What could be a better measure of their performance. The Timken Roller Bearing Company, Canton, Ohio.

When you want high load carrying ability in less space it will pay you to investigate the possibility of using and the advantages in using Timken Bearings.

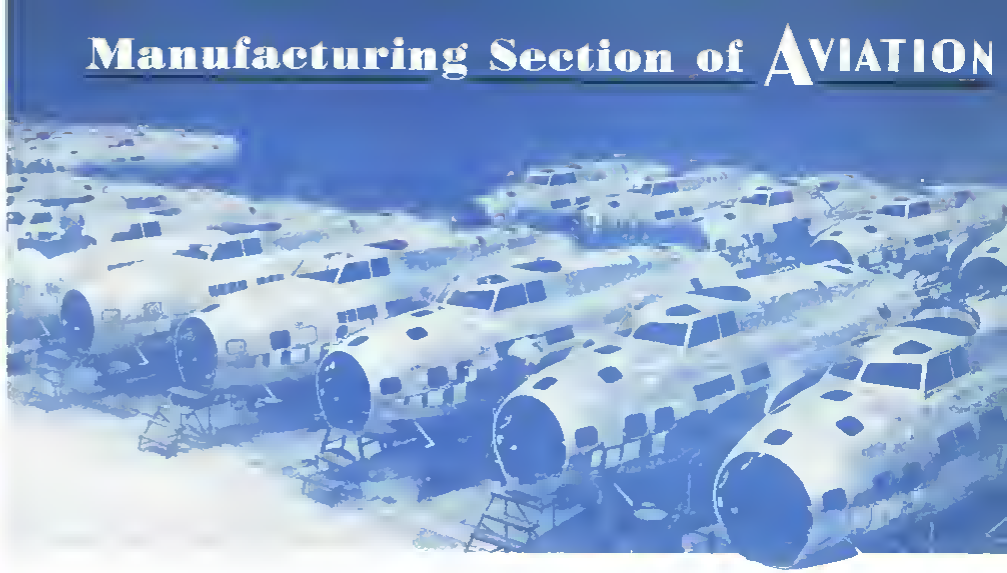
THE ONE TEST FOR EVERY DECISION—
WILL IT HELP TO WIN THE WAR?

"All There Is In Bearings" **TIMKEN**

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS

Manufacturing Section of AVIATION



PRODUCTION • DESIGN • RESEARCH • ENGINEERING

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Good Tooling Simplifies Production of "Flying Fortresses"

By BOYD K. BUCEY,
Superintendent of Tooling, Boeing Aircraft Co.

Correct tooling methods not only speed production of parts but frequently reduce assembly time and make possible employment of more unskilled labor.

WITH MORE THAN 100,000 specially designed tools built and currently in production, and probably an equal number of standard tools which required no design, the Boeing Aircraft Co.'s tooling department is in high gear for the production of the Boeing *Flying Fortress*, one of the many tools of victory. This 200,000 figure is exclusive of the commercially produced tools, such as lathes, pneumatic riveting hammers, electric drills, and the like, which are listed at Boeing as plant equipment. Including these, the tools used to produce the *Flying Fortress* would total more than 250,000. These implements of production have been turned out since the declaration by the President of the state of national emergency. But the tooling organization at Boeing which made this record has not always been in existence.

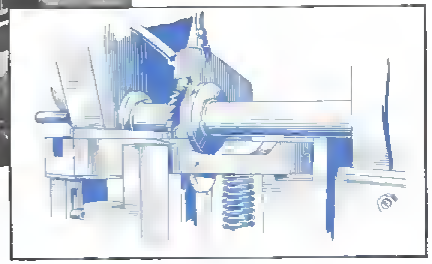
Growth of the tooling department at Boeing has paralleled the increase in *Flying Fortress* production. Quantity production of any product cannot be achieved without the tools necessary for increased output.

In former days, before the ugly threat of war reared its head in Europe, the Army Air Corps considered 40 *Flying Fortresses* in a year to be a substantial order. Extensive tooling played a role in the production of such orders, the tooling activities being devoted to the building of drop hammer dies, the designing and building of jigs and fixtures, which in most instances seldom exceeded one or two of each kind. Templates were made to check accuracy, and other devices which aided production were built.

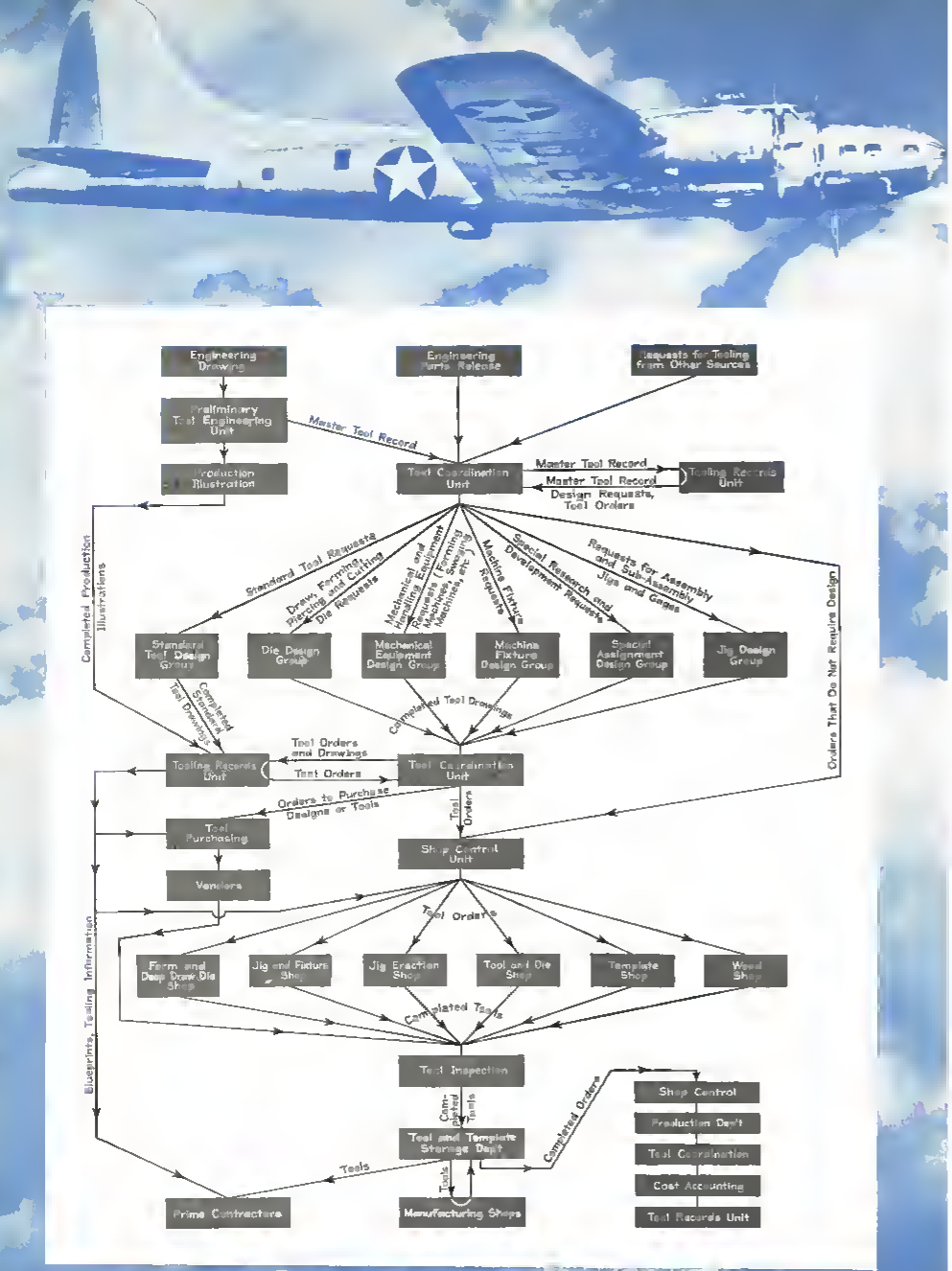
Prior to 1930, at the Boeing Aircraft Co.'s plants in Washington, tools were planned in the shops and built by the men who built the planes. In those days, when the all metal plane was just being introduced, if a new or different rivet backing bar were required, a man got a piece of scrap metal and ground one out to the desired shape. Special tools, as they were required, were developed by a group reporting directly to the factory superintendent. In those days, the Boeing plant, while one of the largest in the nation, employed less than 3,000 persons. With most of the personnel being highly skilled workers, and by and large familiar with the problems involved throughout the construction of the small orders of planes which aircraft companies managed to obtain, extensive tooling was not economically practical. At present, the tooling department alone almost equals the total Boeing payroll of more than a decade ago.

About 1930, one man in the department began to design tools which aided in the production of the Boeing 247. This ship, the forerunner of the modern air transport, marked an innovation in aircraft construction. Boeing's order for the ship was quite substantial and because no commercially produced tools were available, special tools had to be built for the job. Wing spar drill jigs, riveting mice, standard tools such as angle drills, punch and die blanks, and the like, were designed for the more rapid production of the transport ship that brought nonstop travel into the three mile a minute class.

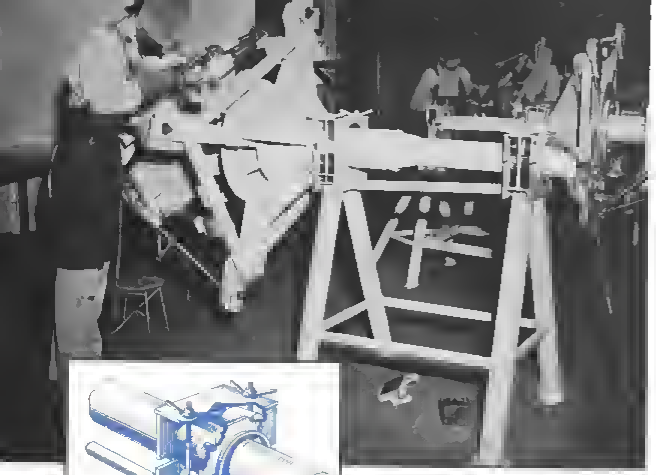


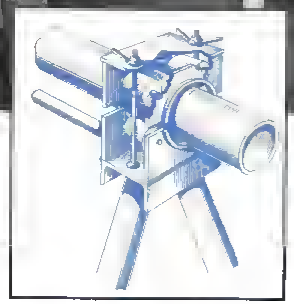


Milling irregular contours is a tough problem even for experienced men. A young woman with no experience in this work here demonstrates ease and simplicity of task using a Boeing developed milling fixture. Round wheel mounted on same shaft (see inset) follows irregular contour of pattern.



Tooling Flow Chart. This chart depicts tooling department procedure





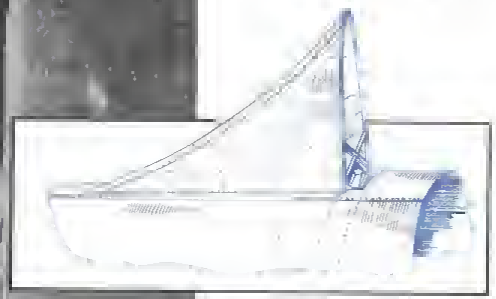
This elaborate welding jig holds many pieces of "Flying Fortress" engine mount in accurate alignment while welder rapidly joins them into single unit. Rotatable jig (see bearing detail, inset) makes for maximum accessibility of work and fast welding.



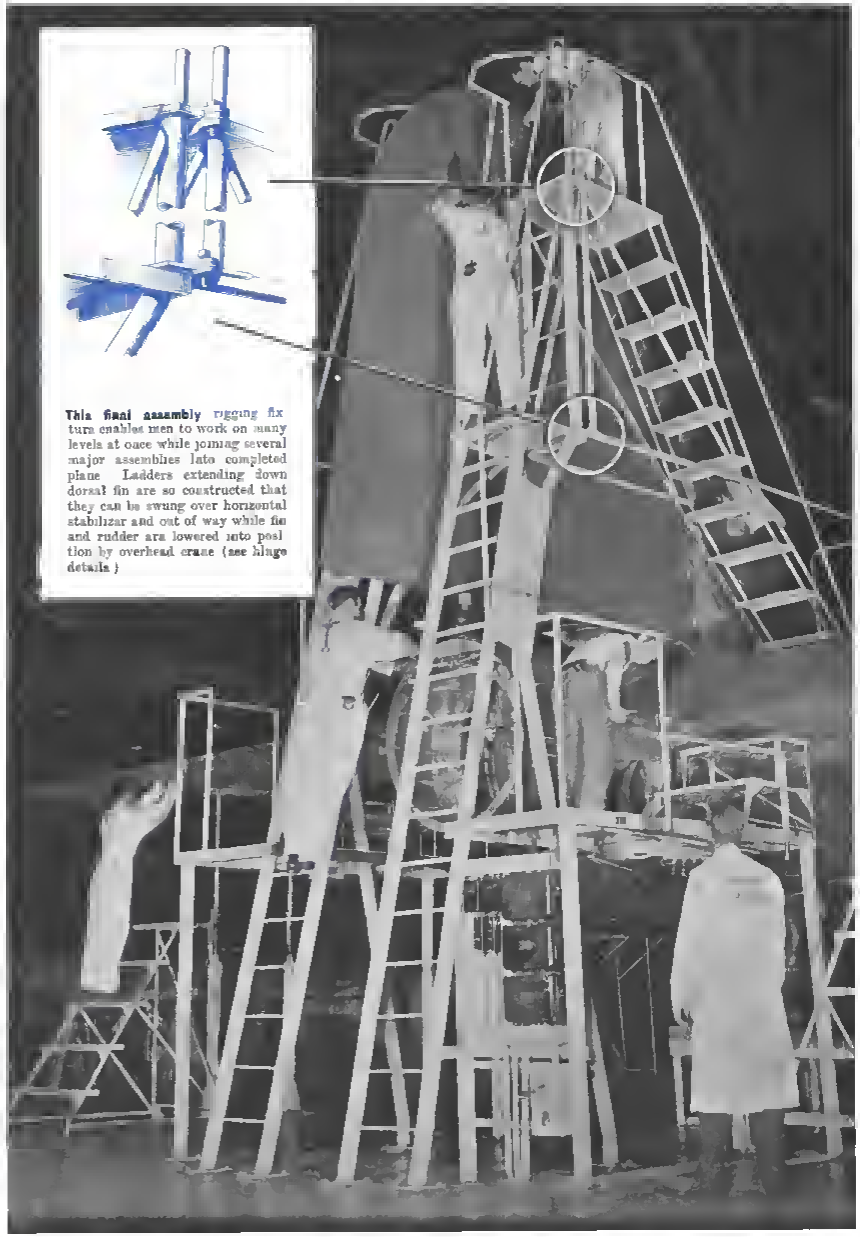
In those days, the tool records consisted mainly of a rubber serial number stamp and a stenographer's notebook in which the item was recorded, as well as where it could be found in the plant. Machining fixtures, drop hammer dies, and the like, were made in the shops by skilled workers, direct from engineering prints, and without the necessity of tool design. Complete interchangeability of parts was not as great a prerequisite of production in those days. Tool planning at Boeing was then under the production office, and was not a separate department. Design of special machines, jigs, tools, etc., was handled, as formerly, with the equipment engineers.

Boeing designed planes, over a period of years, brought about a complete change in the trend of aircraft, from the tri-motor to the bi-motor 247, from the Army B-9 to the Boeing 299, the original *Flying Fortress*. Subsequent development of four engine commercial planes, such as the *Stratoliner*, the *Clipper*, and the many models of the *Flying Fortress*, led to Boeing's establishment of a tooling department called Engineers of Manufacturing, a fairly complete unit which planned tools, designed tools, and followed through in the manufacturing shops to see exactly what tools were most urgently required to expedite production. Just prior to this time a tool fabrication shop was organized, separate from the machine shop, and manned by skilled machinists and tool and die makers. A jig shop, comprising primarily welding experts, was divorced from the production welding shops to work exclusively on the building of jigs for the production of four engine planes.

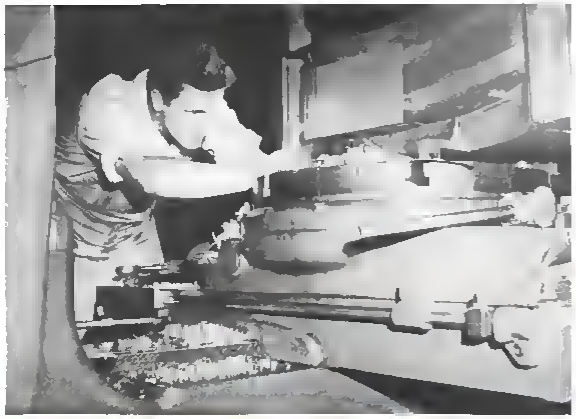
During 1940 the present tooling department, an expansion of the Engineers of Manufacturing, was formed to handle tooling in all its phases. Design,



Even production illustrations fall within province of Boeing tooling department. Simple perspective sketches (see inset) and detail drawings, accompanied by clear instructions, tell worker every step to make and sequence of operations.



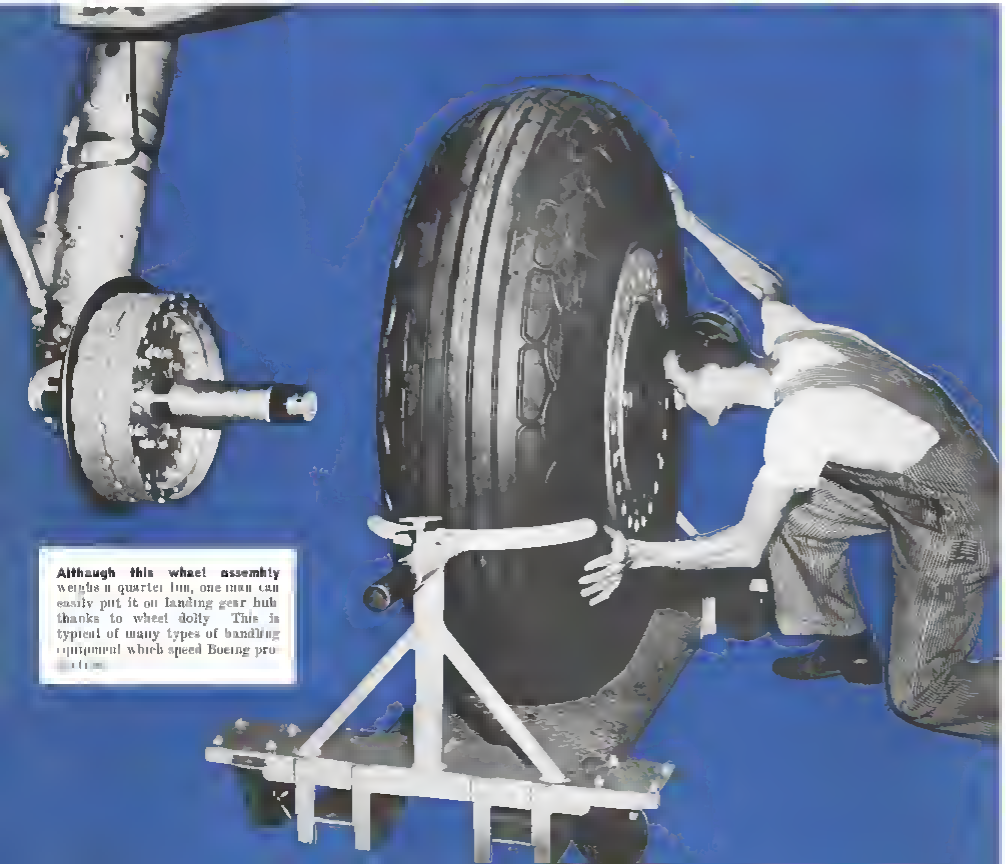
This final assembly rigging fixture enables men to work on many levels at once while joining several major assemblies into completed plane. Ladders extending down dorsal fin are so constructed that they can be swung over horizontal stabilizer and out of way while fin and rudder are lowered into position by overhead crane (see blueprint details).



engineering, and fabrication. Vastly increased orders for the *Flying Fortress* and previous plant expansion in separate areas called for more design of tools and more detailed planning of tools which were needed for production. Problems which formerly could be solved by personal contact could no longer be handled. Instead of drop hammer dies of the past, double and triple action deep draw dies came into use in the fabrication section, using huge mechanical and hydraulic presses.

Jigs were built in batteries. Now and at present, a deep draw die makes one part which is spot welded to the skin

Vertical planers like this one speed production of dies for fabrication of "Flying Fortress" parts. Constant improvement of dies is part of Boeing tooling program, seeking ways of making one die perform several functions



Although this wheel assembly weighs a quarter ton, one man can easily put it on landing gear hub thanks to wheel dolly. This is typical of many types of handling equipment which speed Boeing production.

highly specialized machines, designed and built by Boeing, took their places along the production lines. Special pieces of handling equipment were devised to expedite the moving of large heavy parts or assemblies. Through extensive tooling, Boeing got into quantity production of the Boeing *Flying Fortress*, the ship which no less authority than Gen. Arnold has called "the guts and backbone of our worldwide aerial offensive."

Frequently, in the process of manufacturing an article, the determination of the amount to be spent on tooling is based on the following factors making up the cost of the finished part: Cost of the tool, plus the cost of the labor which uses the tool, plus the amount of material wasted, totaled, then divided by the number of parts which are required to manufacture the finished product. Boeing has gone even further. It has been determined that this fabrication cost frequently used in computing the cost of the part represents only 20 percent of the total labor cost of producing the plane. The remaining 80 percent is the time required to assemble the parts into the finished aircraft. Consequently, anything which tooling can do to shorten the amount of assembly time required for each *Flying Fortress* results in



This huge Gray planer, with 20 ft. [illegible] used for large planing operations

speedier production at a lower labor cost per ship. If the tooling cost seems higher than the part itself might justify, but the assembly time is reduced, the tool is scheduled into production.

One typical example of this is the method of making the doors to the ship. Former practice was to rivet about 40 pieces together making the door. At

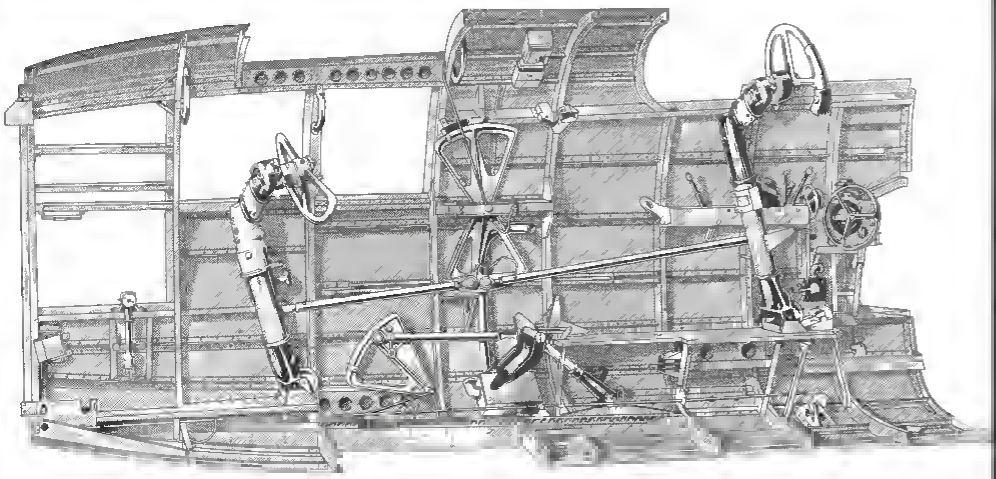
(*Turn to page* 221)



Huge automatic spot welding machines [illegible] panels of aluminum [illegible]



Among many types of tools made by Boeing's tooling department are gages for checking jigs in which assembled [illegible]



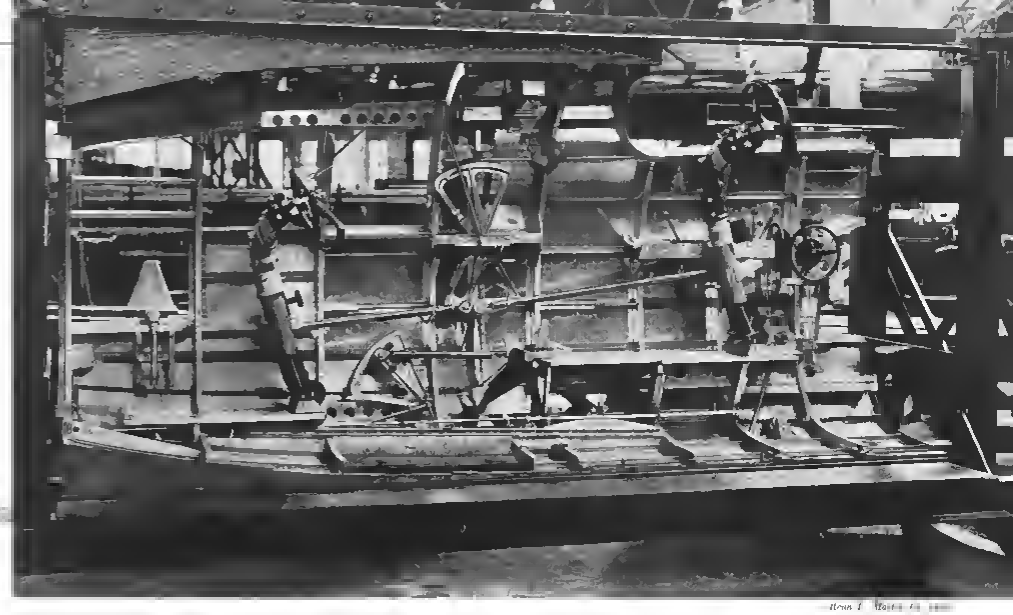


Fig 2. Photo vs. pictorial drawing (above and opposite page) In these views of fuselage "half shell" section, clarity of detail is obviously superior in the pictorial sketch.

Theory and Technique Of Perspective Projection

Part 1

By **GEORGE F. BUSH**, *Assistant Professor of Graphics, Princeton University*

Increasingly favored on aircraft production lines, perspective engineering illustrations are both supplementing and replacing ordinary blueprints—thus creating a wide demand for personnel trained to execute these drawings. First of a series on graphical projection fundamentals, this article details one-point perspective principles.

Pictorial drawings and sketches, employing isometric, oblique, and perspective projections, are superior in the average case to the conventional engineering drawings using orthographic projection, in so far as immediate shape-description is concerned. They can reveal at a glance the essential shape and the basic component parts of an object. And to read them requires little or no training.

Because of these advantages, the spotlight of industry and the armed services has been focused on pictorial drawings and sketches. For the semi-skilled and unskilled workers, which industry and the armed services must now somehow use to achieve the victory, can easily read this type of engineering drawing, although they may not know how to read the conventional engineering drawing.

As an example, Fig 1 is a freehand perspective of a hydraulically operated tank brake for an Army light tank can easily be read "out in the field" by maintenance, installation, repair, or assembly groups of the United States Army; yet many of these readers have never been formally trained to read engineering drawings.

In these days of total war, when, for the first time, women are entering and succeeding in fields of labor formerly occupied solely by men, the role of the pictorial drawing and sketch assumes greater significance.

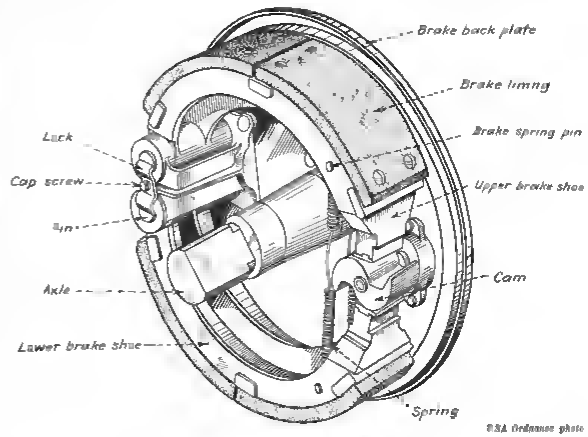
It is apparent that, paeing the increasing demand for more and more pictorial sketches and drawings, we now find an increasing demand for persons skilled in the making of such drawings and sketches. The supply of such skilled persons has always been subnormal. It is no small wonder, then, that the aviation industry, for example, is in crying need of trained personnel who can draw and sketch perspective illustrations.

It is hoped that this series of articles will, first of all, help fill this aching void of skilled makers of pictorial (perspective) drawings and sketches by supplying sound theory with practical applications in a clear, brief, and systematic manner. And, secondly, that the new methods described herein will attract, and not scare off, those individuals whose first love of a subject is killed by an unnecessarily complicated theory and application.

All comments and suggestions, particularly those relating to further applications of the ideas presented here, will be greatly appreciated by the author.

Of all the pictorial projections, perspective is the only one which will represent the object without distortion. *Common* perspective will represent it as seen by one eye of the observer, *exact* perspective as seen by two eyes. This freedom from distortion is one of the main reasons for using this type of projection in making the pictorials now playing an increasingly useful and important part in our wartime and (later our peacetime) production.

Photographs may or may not provide the same pictorial clarity of the drawing or sketch. Certainly, in a large number of cases they will be found unsatisfactory, even after extensive retouching and doctoring, because they lack either the clarity of outline or the simplicity of a smart line-sketch. It is true that a photograph can be made more quickly, but, as exemplified by Fig 2, it will be found generally unsatisfactory, because shadows often obscure important parts, highlights often emphasize unimportant parts, non-essential parts may be shown, and details may be lost.



U.S.A. Ordnance photo

Fig. 1. Perspective sketch of hydraulically operated tank brake

* A book, *Engineering Sketching*, is being prepared by Mr Bush for early publication.



Fig. 3. This view of steam, water, and electrical conduits in trench [illegible] plant offers example of how parallel lines converge to distant point in perspective

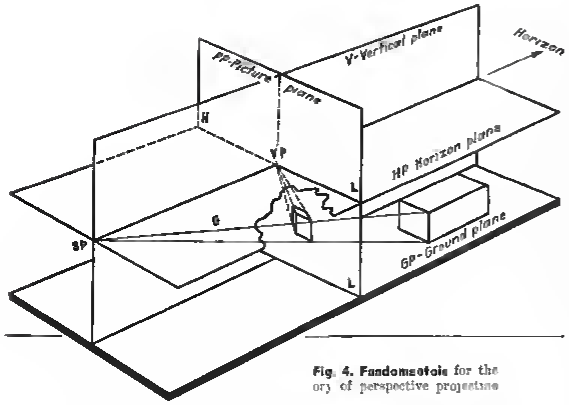


Fig. 4. Fundamentals for theory of perspective projection

PP—Picture plane

HP—Horizon plane (mutually perpendicular)

V—Vertical plane

GP—Ground plane

H . . . L—Horizon line (parallel to *HP*)

G . . . L—Ground line (intersection of *HP* & *PP* and *GP* & *PP*)

SP—Station point (an eye)

VP—Vanishing point (a point to which parallel lines of a set converge)

CV—Center of vision (point common to *HP*, *PP*, and *V*)

Practically every one knows from observations in nature that parallel lines—horizontal ones, let us say—will converge at a distant point. An example of this phenomenon is given by Fig 3, in which it is evident how all the horizontal lines which are parallel—lines like the overhead water pipes, the suspended steam mains, the edges of the side wall and floor—converge to a point.

This point convergence of horizontal, parallel lines is also shown by Fig. 4, which likewise graphically indicates the definition of the word "perspective" (i.e., to see through). The box, resting on *GP*, is "seen through" *PP*. The interception of the object, by the *PP* is the perspective view of the object. Fig 4 also shows that the *PP*, *HP*, and *V* are all mutually perpendicular. Since *V* is vertical, *PP* is vertical, since *HP* must be horizontal. The observer stands on *GP*, which is horizontal, and one eye is *SP*, in *HP* and *V*. *GP* and *HP* are assumed always parallel, so that *HL* is the intersection of *HP* and *PP*. The horizon lies in *HP* far beyond *PP*. *GL* is the intersection of *GP* and *PP*. Unless otherwise indicated, the *PP* will always stands between *SP* and the object.

One-point Perspective

The simple case of one-point, or parallel, perspective, in which the x z plane of the object is in *PP*, is shown by Fig 5. As is common practice the perspective is there drawn under the top view in the space which the front view in orthographic projection would normally occupy. The end and top views of Fig. 5 show the box on *GP*, and the *SP* located at *HL* elevation to the left of the object.

In Fig 5 showing construction for one-point perspective two methods are explained. Method 1 is termed the "piercing point" method while Method 2 is termed the "vanishing point" method. The superiority of Method 1, for the general case, will be established.

If the construction under Method 1 has been accurate, it will be found that all horizontal parallel lines, like *AB*, *CD*, *EF*, and *GH*, will converge at *VP* on *HL*, and that *VP* lies on a perpendicular to *PP* (in the top view) drawn from $(SP)^1$. This VP is the vanishing point which must first be determined if Method 2 is used.

Comparison of Methods 1 and 2 definitely shows that in one-point perspective the advantage lies with Method 1, and as will be demonstrated later, this method is better for the general case. The reason for this is, chiefly, that it is not necessary to locate *VP* in Method 1. Strength of this advantage will become apparent in the solution

(*Turn to page* 125)

The B.F.Goodrich Airplane of the month

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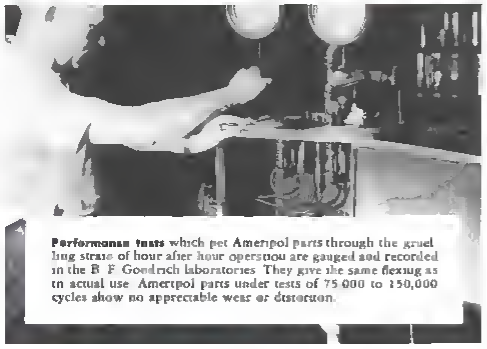
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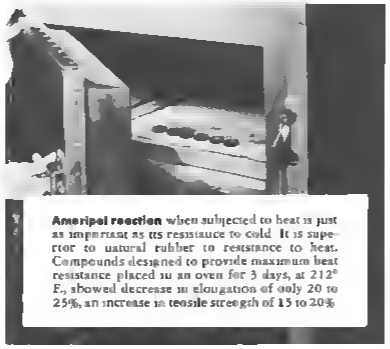
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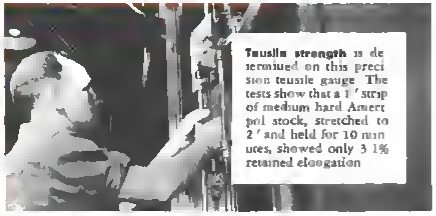


Performance tests which put Ameripol parts through the gruelling strain of hour after hour operation are gauged and recorded in the B. F. Goodrich laboratories. They give the same flexing as in actual use. Ameripol parts under tests of 75,000 to 150,000 cycles show no appreciable wear or distortion.

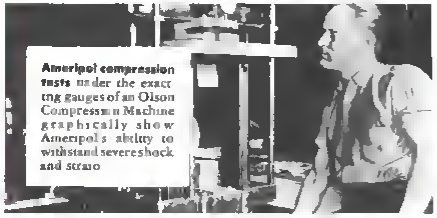


Ameripol reaction when subjected to heat is just as important as its resistance to cold. It is superior to natural rubber in resistance to heat. Compounds designed to provide maximum heat resistance placed in an oven for 3 days, at 212° F., showed decrease in elongation of only 20 to 25%, an increase in tensile strength of 15 to 20%.

AMERIPOL the B. F. Goodrich synthetic rubber, has properties of great importance to aircraft performance!



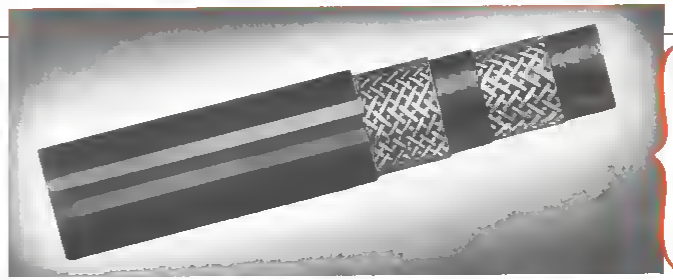
Tensile strength is determined on this precision tensile gauge. The tests show that a 1" strip of medium hard Ameripol stock, stretched to 2" and held for 10 minutes, showed only 3.1% retained elongation.



Ameripol compression tests under the exacting gauges of an Olson Compression Machine graphically show Ameripol's ability to withstand severe shock and strain.

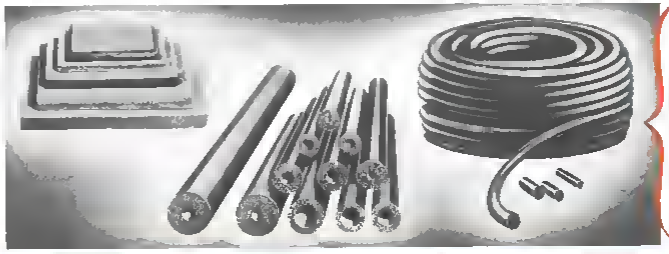


Ameripol sompoond placed in a refrigerated vault and subjected to sub zero temperature of —50° F. for as long as one week MAINTAINS its NORMAL flexibility. It can be bent on a 180 degree angle around a 3/8" rod while still at —50° F. without checking, cracking or breaking. Actual operation tests at —50° F. by aviation authorities reveal the same results.



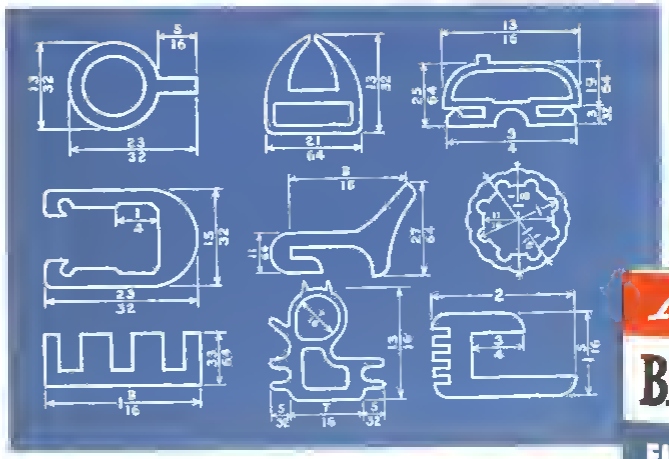
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B. F. Goodrich Fuel Hose is made with a synthetic tube and cover, and two braided inserts. The synthetic rubber is gasoline resistant, and prevents peeling and swelling. (Ordinary hose should never be used for gasoline, since gasoline attacks the interior, causing it to crumble and clog the fuel system with small particles of rubber.)



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of problems where the *VP* is so distant that special methods must be resorted to in order to complete the projection by this method—or in advanced perspective projection where special inclined *VP*'s must first be found, sometimes by trick solutions which purportedly represent a simplification of a rather complex construction. Also, in advanced perspective projection, involving worm's-eye and bird's-eye views, the advantage of Method 1 is indisputable.

In some cases, such as those in which there are a large number of lines in the parallel line-set, Method 2 may be found more applicable for a particular *VP*. A combination of Methods 1 and 2 may often prove the simplest solution. It is true that Method 1 requires the location of the end view of *SP*, but this is *always* a simple matter, because this end view is always near *PP*.

Finally, the fundamental nature of Method 1 has been clearly established in one-point perspective where, by development of the two methods, the *VP* of Method 2 was deduced from Method 1. As will be learned from subsequent treatments of other perspectives, this deduction is always possible. Since a combination of Methods 1 and 2—let us call this combined approach Method 1-2—may sometimes prove best, both methods will be explained in detail in the theory.

In Method 2 it is always necessary to find *VP*. The following principles may be used to deduce the location of the *VP* in some cases. Method 1 can be used not only as a check on these locations but also to deduce the locations of the *VP* in the remaining cases.

Principle 1—The perspective projection of a point is the intersection of the perspective projections of two lines through that point.

Principle 2—Each set of parallel lines in space has its own *VP*, which is located from points where sight lines, parallel to the set, pierce *PP*.

An application of Principle 1 has been indicated in Fig. 5, under Method 2, items 2 and 3. Referring to Fig. 5, the perspective projection of the point *A* is the intersection of the perspective projections of, say, the two lines *AB* and *AE* through point *A*. The perspective projection of *AB* is a perspective from *B* to *VP* and the perspective projection of the line *AE* is on a vertical line dropped from A^T. The intersection of these two line perspectives is A^P.

Regarding a general application of Principle 2, the locations of *VP* in all cases has been tabulated in Table I on page 349.

Referring to Table 1, condition I (1) has already been demonstrated, for example in Fig. 5 under Method 1. As there shown, *AB* is a horizontal line perpendicular to *PP*, hence its *VP* is in *HL* and *V*. Condition I (2) with the line-set parallel to *PP*, indicates that the *VP* is in *HL* but an infinite distance to the right or left. Hence, the perspective projections of all lines par-

(*Turn to page* 349)

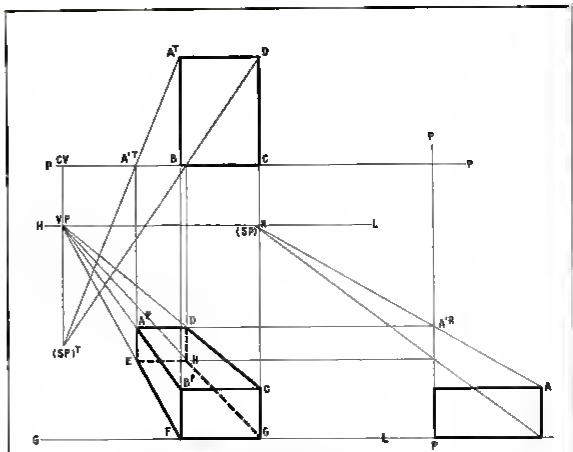


Fig. 5. One-point perspective by two methods (front of object to *PP*).

Method 1.

Piercing point method

1—Draw end views of *PP*, *SP*, and the box (if necessary). Position of *SP*, in relation to the box, is assumed known, i.e., the distance that *SP* is in front of *PP*, or $(SP)^T$ to *CV*. In the end view, $(SP)^R$ will be the same distance from the end view of *PP*, and in *HL*.

2—Determine in the top and end views where sight lines (from *SP* to points on the object) pierce *PP*. For example, the point A^T is where a sight line from $(SP)^T$ to *A*, the back, upper, left corner of the box, in the top view, pierces *PP*, in the top view; and the point A^R is the corresponding piercing point in the right end view of *PP*.

3—Using the piercing points obtained in 2 (above), determine the perspective views of points on the object by projecting down from the top view of *PP* and over horizontally from the end view of *PP*. For example, where a vertical projection line from A^T intersects the horizontal projection line from A^R is A^P, the perspective view of point *A* of the box.

4—Determine enough perspective views of other points on the object to determine its complete perspective.

Method 2.

Vanishing point method

1—Determine the *VP*. In this case, it will be in *HL* where the perpendicular from $(SP)^T$ to *PP* intersects *HL*, as was deduced by Method 1.

2—Using top and end views, determine the perspectives of, say, all horizontal lines of the box. Recall from Method 1 and Fig. 4 that these perspectives run from *PP* piercing pts. back to *VP* in *HL*.

For example, since the front face *BCGF* of the box is already in *PP*, B^P is where a line, containing the horizontal line *AB*, pierces *PP*. The perspective of this containing line is therefore drawn from B^R to 1 P.

3—To find points on these line perspectives, find in the top view where sight lines to the points pierce *PP*. Where a vertical projection line from these piercing points in the top view intersects the perspectives found in 2, immediately above, is the perspective of the point. For example, to find A^P on the above containing line, drop a vertical projecting line down from the top view of the point where the sight line from $(SP)^T$ to A^T pierces *PP*. The intersection of this vertical projection line with the perspective found in the example in 2, immediately above, is A^P.

4—In a similar manner determine enough perspective views of other points to complete the object in perspective.



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Legal Requisites for Labor Standards In the Aviation Industry

Resume of two basic labor laws—the Walsh-Healey Act and Wage-Hour Law—detailing the definitions and extent of their applications in the aviation field.

TWO LAWS that set up labor standards applying to the aviation industry are the Walsh-Healey Public Contracts Act and the Fair Labor Standards Act, commonly called the Federal Wage and Hour Law.

The Wage and Hour Law applies to employees engaged in interstate commerce or in the production of goods for interstate commerce. Unless specifically exempted by the Act, all such employees must be paid not less than 30c an hour and not less than time-and-a-half regular pay for all hours worked beyond 40 a week. There is, of course, no limitation on the number of hours employees may work, provided "overtime begins at 40."

The Walsh-Healey Act, passed June 30, 1936, applies generally to government contracts for materials and supplies in excess of $10,000. This Act fixes standards of maximum hours, overtime compensation, child labor, and safety and health, and it prohibits the employment of convict labor in the fulfillment of contracts covered by the Act.

Minimum wages required under the Walsh-Healey Act are those which the Secretary of Labor has determined to be the prevailing minimum wage for specific industries in particular localities. So far such wage determinations have been made for some 56 industries with wage rates ranging from 30 to 70c an hour. In no case are these minima lower than those established under the Fair Labor Standards Act.

Since Dec. 29, 1938, the minimum wage for aircraft work subject to the Walsh-Healey Act has been 50c an hour. This rate applied to: Work on military airplanes; commercial airplanes of 5,000 lb gross weight or over; and engines, propellers, parts, and accessories. An amendment to this wage determination, effective Nov. 18, 1941, excluded commercial airplanes under 5,000 lb gross weight, the engines and propellers therefor, and also the parachutes, instruments, and radios. A further amendment, effective May 7, 1942, brought the following products within the scope of the definition covering the aircraft manufacturing industry:

Light commercial aircraft, engines and propellers for such aircraft, parts and propellers for light commercial aircraft and their engines; and propellers, gliders, and specialized servicing equipment.

This last amendment excluded from the scope of the definition such commodities as: Fabricated textile products, electrical and radio equipment, rubber products, machine shop products and machinery, miscellaneous products such as cameras, fire extinguishers, first aid equipment, gaskets, instruments, lavatory equipment and lighter-than-air craft.

This same wage determination permits the employment of apprentices at less than the 50c. hourly minimum if their employment conforms to the standards of the Federal Committee on Apprenticeship.

BASIC STRAIGHT TIME hours of work under the Walsh-Healey Act are 8 in any one day or 40 in any one week. Overtime is permitted, of course, if time-and-a-half of the basic rate is paid for all hours worked beyond these limits. For example, an employee whose total work week consisted of four 10-hr days would be entitled to 8 hr at time-and-a-half under the Walsh-Healey Act. But under the Wage and Hour Law, which makes the work-week its standard, he would not be entitled to such overtime, since his hours of work in that week did not exceed 40.

Where an employee worked, let us say, five 10-hr days and one 5-hr day during a week, he would be entitled to 15 hr. at time and a-half under either law.[1]

In general, the Walsh-Healey Act prohibits the employment of boys under 16 and girls under 18 years of age. Until further notice, a special exemption permitting employment of girls between 18 and 18 years of age in the fabrication of metal products (including non-ferrous metal products) is effective. These girls, however, may not work more than 8 hr. a day and may not work between 10 p.m. and 6 a.m. All convict labor is prohibited.

The Walsh-Healey Act requires that goods supplied on a government contract be manufactured or handled under safe and sanitary working conditions. In locations where state laws establish safety and health standards, observance of such regulations will be taken as prima facie evidence that employers are in compliance with these provisions of the Walsh-Healey Act.

Not only the aviation industry but many others are now largely given over to production of war materials, and this has meant that a great many employers are subject to both the Wage-Hour and the Walsh-Healey Laws. The agencies charged with enforcing these Acts cooperated closely in the past. To further facilitate the work of administration and enforcement, the two agencies have been merged under an order of the Secretary of Labor. Now called the Wage and Hour and Public Contracts Divisions of the U. S. Department of Labor, the combined divisions are directed by L. Metcalfe Walling, the present head of the Wage and Hour Division, who was also the first and only Administrator of the Public Contracts Division.

EXCEPT IN THE CASE of certain Defense Production Associations, the Walsh-Healey Act requires that every contractor be a manufacturer of, or a regular dealer in, the materials or supplies to be furnished under the government contract. Where a dealer has a manufacturer deliver goods directly to the federal government, he will be considered an agent of the manufacturer, and the latter's employees will be subject to the provisions of the Walsh-Healey Act while they are engaged in any operation necessary to fulfillment of a Government contract above $10,000.

In cases where a manufacturer buys materials or parts to be used in producing the commodity called for by his contract and it is a regular practice in his industry to purchase such supplies and not to manufacture them, the work performed by the vendor is not subject to the Act. For

(*Turn to page* 319)

1. Employers who enter into certain collective bargaining agreements with their employees pursuant to provisions set forth in the Fair Labor Standards Act may employ them up to 12 hr a day or 56 hr a week without the payment of time-and-a-half for overtime.



Strength Properties Of Plexiglas

Part I

By W. F. BARTOE

Chief Physicist, Rohm & Haas Company

Through searching tests of Plexiglas, aircraft designers and engineers are guided to the most effective applications giving the most efficient service. Herein are detailed basic and impact-strength factors. Concluding article will cover tensile and flexural strength.

CONSIDERATIONS OF STRENGTH—impact, tensile, and flexural—are primary in designing Plexiglas applications for aircraft structures. Here, in Part I of this two-part article, we shall discuss fundamental strength factors and impact-strength tests and results. And in Part II (to appear in February AVIATION) we shall deal with tensile and flexural tests.

First off, in testing the strength characteristics of Plexiglas the following factors must be considered:

1. *Temperature:* Plexiglas is a thermoplastic resin and, as the term implies, its properties vary with temperature. Some thermoplastics are quite brittle at freezing temperatures. Practically all of them are relatively soft and pliable at the temperature of boiling water. Plexiglas, because it contains no plasticizer and because of its inherent physical structure, loses relatively little of its strength at low temperatures, and also resists slightly higher temperatures than other types of thermoplastics before softening.

Even so, temperature changes affect its mechanical properties more so than similar changes would affect the properties of metals, wood, glass, and other construction materials. Range of temperatures to which Plexiglas will be subjected during service should definitely be borne in mind when planning an installation.

2. *Thickness:* Strength of any Plexiglas section will also depend on thickness of the material, and behavior of Plexiglas in this respect is not especially different from that of other resilient materials. In the following sections, wherever pertinent data on the effects of thickness on strength characteristics are available, the nature and extent of these effects will be considered in detail.

3. *Size and Shape:* As with thickness, the size and shape of a piece of Plexiglas often influence its strength. In general, behavior of Plexiglas of various sizes and flat shapes is approximately the same as might be expected with other moderately flexible materials.

Here again, wherever significant, effects of size and shape of a test sample will be covered in greater detail in hope that the results of these tests will be of value in predicting the service that can be expected in a given installation.

Curved Plexiglas shapes, especially those in which the material is stretched to any appreciable extent, offer a different problem. Stretching Plexiglas apparently sets up a "grain" in the direction of the stretch. A quantitative expression of this effect has provided data on the relation between tensile strength and the direction and amount of pre-stretch of the test samples. The data shows that, in a flat unstretched piece of Plexiglas, the relative position of the test samples on the flat cast sheet makes no significant difference in tensile strength, i.e., there is no such grain in flat, unstretched Plexiglas.

4. *Pre-Conditioning:* With many thermoplastics, age, conditioning, and previous history of the test sample materially affect the strength characteristics. Fortunately, none of these factors have too great an effect on Plexiglas, both because no plasticizers (which may evaporate or leach out) are used in its manufacture, and because it absorbs very little moisture. Permanence of its high transparency in the face of severe weathering and sunlight has already been demonstrated.

5. *Rate of Straining:* As with almost all materials, the rate at which the test sample is deformed will affect the result of any strength test or the service which may be expected of the material. In the following sections on impact strength, tensile strength, and flexural strength the extent of this effect is detailed.

6. *Other Factors:* In addition, there enters into any discussion of the physical properties of Plexiglas, the usual experimental variables encountered in any series of tests. Even when the number and extent of these variables are kept to a minimum, there still will be some slight random variations in the individual test results.

Although the data in the following study are subject to the errors which affect all physical measurements, they are more than accurate enough to indicate general principles and orders of magnitude. They are certainly more accurate than most service conditions will ever require.

Impact Strength

In considering impact strength, first let us note the values. All measurements in the following table were made at approximately 25 deg. C.

Charpy (unnotched bar) ..... 3 to 4 ft.-lb (ASTM test method D-256-41T)

Charpy (notched bar) ..... 0.2 to 0.3 ft. lb. (ASTM test method D-256-41T)

Izod ..... 0.2 to 0.4 ft. lb. (ASTM test method D-256-41T)

Falling ball ..... 0.4 to 0.6 ft.-lb. (on 3 in. x 3 in. x 1/2 in. samples)

TABLE I

Thickness	Bullet Impact	Falling Ball	Bag of Shot
060 in.		1.5 ft.-lb	33 ft.-lb
124 in.	13 ft.-lb.	3.7 ft.-lb	78 ft.-lb
250 in.	24 ft.-lb	6.5 ft.-lb	217 ft. lb
875 in.		33.0 ft. lb	
500 in.	55 ft.-lb		
1.000 in.	168 ft.-lb		

TABLE II

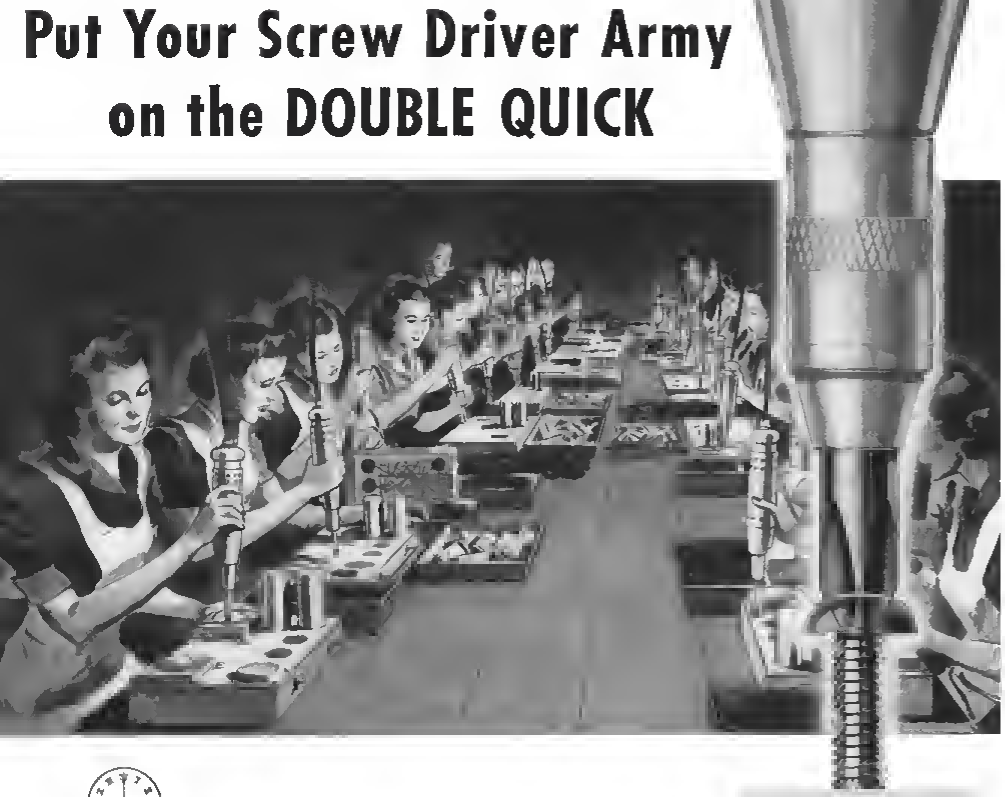
SHAPE OF NOTCH (Charpy Sample)	IMPACT STRENGTH (In Foot Pounds)
A — 0.500"	3.3
B — 0.150" R, Radius 0.075", 0.10", 0.500"	Notch filed only ..... .49 Notch sanded and polished ... .38
C — 0.150" R, Radius at taper 0.01", 0.10", 0.500"	3.3
D — 4/64", 5/64", 0.500"	2.0

TABLE III

Condition of Tension Surface	Charpy Impact Strength	Maximum Flexural Strength
A. Polished to remove scratches	3.6 ft. lb	13,760 psi
B. Sawed	2.8 ft. lb	13,000 psi
C. Passed through planer so that scratches are parallel to long dimension	3.4 ft.-lb	13,400 psi
D. Passed through planer so that scratches are perpendicular to long dimension	3.1 ft.-lb.	13,300 psi
E. Sanded on belt sander so that scratches are all parallel to long dimension	3.5 ft.-lb.	13,500 psi
F. Sanded on belt sander so that scratches are all at 45-deg angle to long dimension	3.0 ft.-lb.	12,800 psi
G. Sanded on belt sander so that scratches are perpendicular to long dimension	1.6 ft.-lb	9,530 psi
H. Tension side sanded so that scratches are parallel to long dimension, compression side sanded so that scratches are perpendicular to long dimension	3.2 ft.-lb	13,000 psi
I. Tension side sanded perpendicular, compression side sanded parallel to long dimension	1.6 ft.-lb	9,300 psi
J. Sanded on belt sander so that scratches were perpendicular to long dimensions then remoded so that scratches were parallel to long dimension	0.2 ft.-lb	13,100 psi
K. Sanded on belt sander so that scratches are perpendicular to long dimensions then coated with one heavy coat ethylene dichloride-Plexiglas solution	2.2 ft. lb	13,000 psi
L. Same as K except two medium coats ethylene dichloride-Plexiglas solution	2.2 ft.-lb	13,000 psi

In both the Charpy and the Izod methods for measuring impact strength, a pendulum of given weight and radius is allowed to drop through a given arc to break the test sample. The arc through which the pendulum travels after breaking the sample is used to measure its residual energy. The impact strength (energy required to break the sample) is equal to the energy of

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International Screw Co., Detroit, Mich.
The Lamson & Sessions Co., Cleveland, Ohio
The National Screw & Mfg. Co., Cleveland, Ohio
New England Screw Co., Keene, N. H.
Pawtucket Screw Co., Pawtucket, R. I.
Pheoll Manufacturing Co., Chicago, Ill.
Russell Burdsall & Ward Bolt & Nut Co., Port Chester, N. Y.
Scovill Manufacturing Co., Waterville, Conn.
Shakeproof Inc., Chicago, Ill.

the pendulum blow minus the residual energy of the pendulum.

Difference between the two tests lies in the method of mounting the sample. In the Charpy, the sample is held horizontally and supported at both ends but not clamped. The sample may or may not be notched, as specified. In the Izod, the sample is held vertically and only the lower end is clamped. To prevent any significant shearing effect, a V-shaped notch is cut in the Izod sample so that it will always break at that point rather than in the support.

The falling ball test more nearly simulates actual service conditions. A steel ball is held by an electromagnet directly above the sample and can be dropped simply by breaking the electrical circuit. The ball is dropped from successively greater heights until the sample is broken, and the weight of the ball multiplied by the height of fall gives the impact required to break the sample.

In this test, conducted in our laboratories, the test sample is laid on a substantial metal frame which supports it all along its edges. Bolting the sample rigidly into this frame might affect the results to some extent, but probably not significantly in this test. In ballet impact tests, however, where the velocity of impact is of a much higher order of magnitude, clamping the Plexiglas in a frame is necessary to reduce vibration and to simulate service conditions. Data follow.

Temperature– Impact strength of Plexiglas is less affected by temperature than some of its other properties. As graph M1 indicates, Charpy tests show that the impact strength value remains almost identical for temperatures ranging from −65 deg. C to +70 deg. C for both notched and unnotched samples. Graph M2, drawn from falling ball test data, shows greater variation between the values obtained at various test temperatures, but there is no indication that low temperatures cause an embrittlement in Plexiglas similar to that found in other types of plastics.

KEY TO GRAPHS AND TABLES

Factor	Impact Strength	Tensile Strength	Flexural Strength
1 Temperature	Graph M1 Graph M2	Graph M7	Graph M14
2 Thickness	Graph M3	Graph M8	—
3 Size & shape	Graph M4–6	Graph M9	—
4 Age & preconditioning	—	Graph M10–11	Graph M15
5 Rate of straining	Table I	Graph M12	Graph M16
6 Other factors			
shape of notch	Table II	—	—
surface condition	Table III	—	Table III
depth of scratch	Graph M6	—	Graph M6
pre-stretching	—	Table IV	—
orientation on sheet	—	Graph M13	—

Thickness– Graph M3 shows the relation of impact strength to thickness for a 3 in. x 3 in. area of Plexiglas. Spot tests show that this typical impact strength-thickness curve may be projected to apply with reasonable accuracy to thicker sheets of Plexiglas.

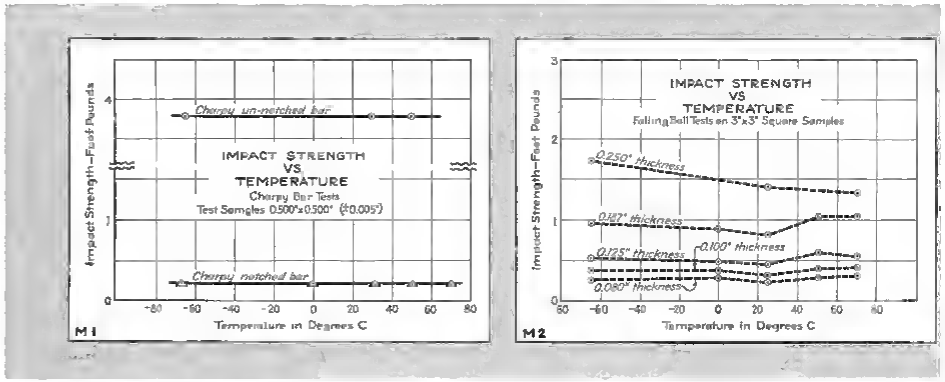
Size– Resilience of Plexiglas naturally enables larger areas to withstand higher impacts than smaller areas. Graph M4 shows this effect for several areas of Plexiglas.

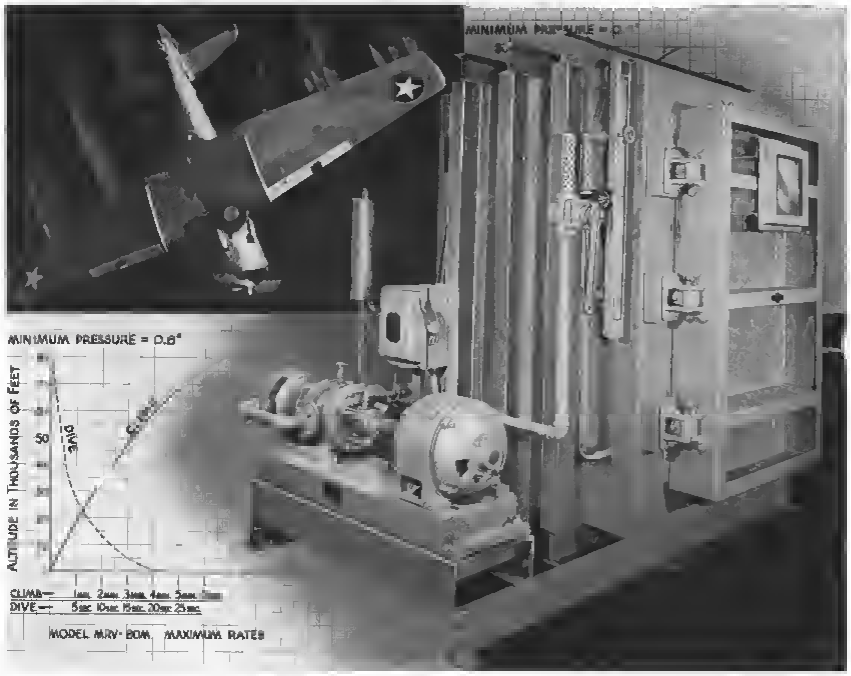
Shape– In Graph M4, data is shown for different shapes of Plexiglas, all 144 sq. in. in projected area. The curves are deceptive to some extent, however, for several reasons. For example, while the curves for the flat disk and for the hemisphere are close, they do not show that failures of the spherical sections were due to cracking rather than to shattering and that the spherical sections could withstand considerably harder subsequent blows without failure or penetration. Also, while the impact strength of cylindrical sections is probably higher than that for flat disks, some of the differences shown in Graph M5 may be due to the fact that the cylindrical samples cannot be as firmly supported and, therefore, yielded when impacted during the tests.

Rate of Straining– At first glance, it might appear almost by definition that in impact tests the fall load is applied so nearly instantaneously that no appreciably different rates of application could be tested. It is obvious, however, that a small bullet travelling at a high velocity and a heavy, flat weight dropped only one foot may apply the same load in foot pounds but that these loads would be of entirely different intensity. Their impact energies would have to be absorbed at entirely different rates.

Since there are no established tests to measure such differences, admittedly arbitrary but logical extremes have been selected for the data in Table I. These figures are based on simple ballistics tests with bullets of different calibres and different muzzle velocities, on standard falling ball tests, and on the bug shot test used in the laminated glass

(*Turn to page* 135)





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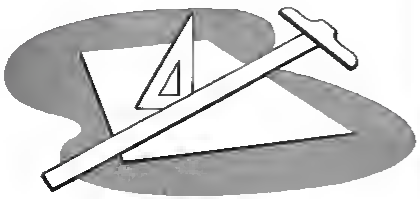
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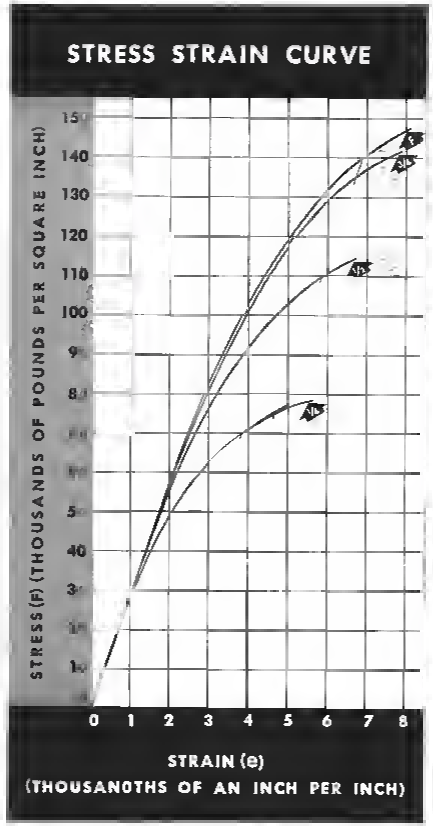


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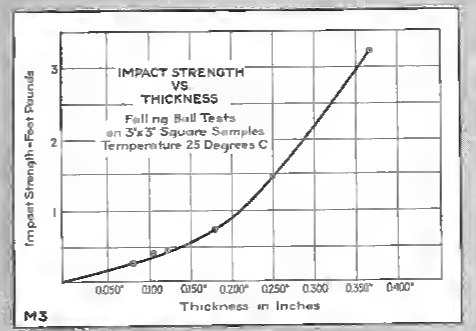
For example, ARMCO High Tensile Stainless saves precious weight in bomb shackles. Equally desirable, it assures split-second response to finger-tip controls because there is little danger of worn parts or of rust causing a bomb to fall too soon or too late.

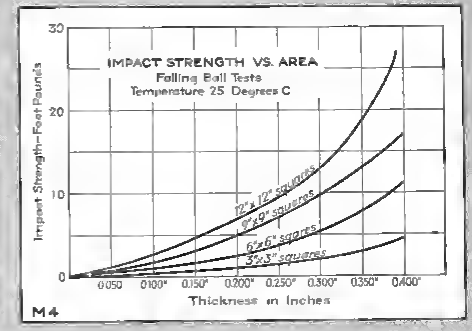
For the same reasons, High Tensile Stainless is indicated for many other parts. These include shroud reinforcements, front tailstacks, nacelle assemblies and armament turret frames.

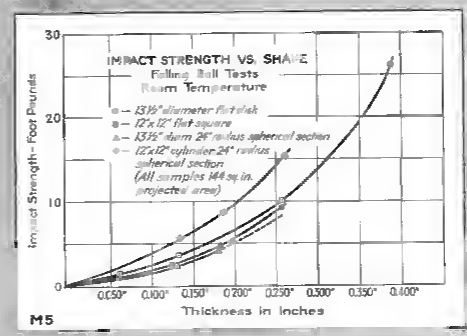
The chart tells *why* ARMCO High Tensile Stainless combines safe, sure operation with less weight. It can be supplied in varying degrees of strength, depending on requirements. The minimum yield strength (p.s.i.) of full-hard ARMCO High Tensile Stainless is 140,000, three-quarter hard is 135,000, half-hard is 110,000 and quarter-hard is 75,000.

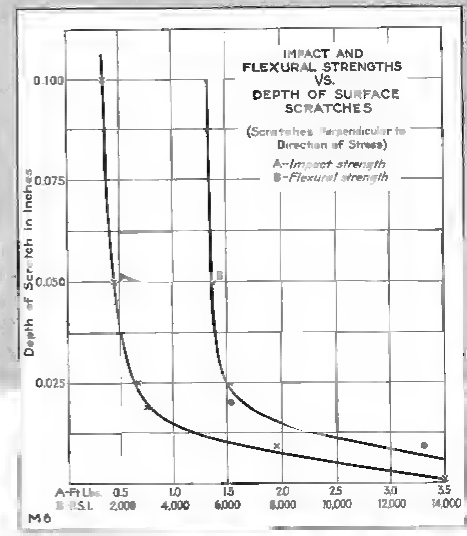
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industry. This last test consists of dropping an 11-lb bag of shot from successively greater heights until the sample cracks.

Other Factors: In Charpy tests on notched samples it has been found that the shape of the notch may affect the test result. Table II shows the effect of three common shapes of notch—all approximately the same depth—on the impact strength value obtained by the Charpy method. The data indicate the desirability of using a round-bottom fillet if the surface of the Plexiglas is to be broken by routing.

Surface condition of Plexiglas, especially the surface subjected to tensile stress, also affects its impact strength. The data in Table III were obtained by the Charpy method. Samples were cut from .500-in. thick sheet in bars of the proper length but approximately .010 in. greater than the final width required. Remaining material was removed by machining in a planer, sanding on a belt sander, or by sanding and polishing, as indicated in the table.

As the results with samples A through G show, impact strength of Plexiglas is at its highest when the tension surface is sanded or planed so that all scratches and ridges are parallel to the direction of stress (which is, in this test, parallel to the long dimension of the sample). Impact strength of samples with polished surfaces was slightly less. And samples planed perpendicularly to the long dimension, or sanded at a 45 deg. angle to the long dimension, or simply sawed, were in a third class. The sample sanded perpendicularly to the direction of stress was definitely weakest, having less than 50 percent of the impact strength of a parallel scratched surface.

Results on samples H and I confirm the logical assumption that the condition of *only the surface where the greatest tensile stress occurs* in the test is the determining factor in these tests.

Our tests with samples J, K, and L further showed that when the perpendicular scratches were replaced by parallel scratches or coated over with an ethylene dichloride-Plexiglas solution, the impact and flexural strengths were practically as high as for the samples A, B, C, D, or E.

Effect of depth of scratches has also been studied, with the results shown in Graph M6. A polished surface was assumed to have no scratches. A single *light* perpendicular scratch was put in another set of samples and a single *deep* scratch in a third set. Four additional sets were also prepared each with V-shaped notches, 0.025 in., 0.050 in., 0.075 in., and 0.100 in. deep, respectively. Scratch depths were .001 in.

As may be seen in Graph M6, the curve resembles a hyperbola. A small change in depth of scratch, up to .025 in. in a .500-in. specimen (5 percent) is accompanied by a large change in impact strength. Beyond that depth, a large change is necessary to produce much reduction in strength.

How to Fair Lines By Graphical Calculus

Part I

By DEAN MADSEN
Lofting Engineer, Northrop Aircraft, Inc.

Mathematical lofting has given greater accuracy, easier development . . . has saved time, space, labor costs. Now comes a new significant advancement—the Madsen Method. Here are the fundamental steps and integer-station procedure.

GREAT STRIDES in the advancement of lofting technique have been made in the last few years. And herein is set forth not only a method combining what we believe are the best of these developments but also an introduction to a new idea which greatly simplifies the process of obtaining a truly fared surface.

In presenting this new method—the adaptation of calculus to the problem of fairing—we are offering a method which effectively eliminates lengthy calculations and complicated formulas. In their place we give a simple graphical method of obtaining a perfectly faired and defined double curved surface, any point of which is available to an accuracy of 0.001 in., a dimension consistent with what can be used in actual practice.

Lofting methods based upon mathematical principles have been of decided value to the aircraft industry, for they have—

Saved valuable time in the lines development.

Eliminated the use of a loft 'floor," thus saving space.

Introduced a saving of labor costs through the saving in time.

Made the final lines much more accurate and complete.

Made the development physically easier.

With such benefits, it seems obvious that the newer methods are progressive. Much has been gained—with little or nothing being lost.

However, there still seemed to be room for additional simplification of processes without sacrifice of any advantages already gained. To this end our graphical calculus takes us.

In applying calculus to the fairing of lines, we study the line in regard to its slope and rate of change of slope, i.e., its first and second derivatives. Such a viewpoint is basically sound since a line is either fair or unfair by the manner in which it changes direction. Also, fairing by this method is aerodynamically sound, because if a line is fair in its first and second derivatives the radii of curvature, $\frac{(1+y'^2)^{3/2}}{y''}$, will also be fair.

A new method not only must be basically sound but must have advantages over old methods, advantages of graphical calculus, in addition to those already named, may be summed up:

All steps are mechanical.

They are simple and easy, no knowledge of calculus being needed.

Complicated formulas and computations are eliminated.

No calculating machine is needed.

Visual analysis of line obtained.

Lines fair in their first and second derivative.

We have said that our general method is a combination of the best developments to date. Before going into a detailed explanation of the graphical calculus, let us investigate just what this combination is.

After consideration of all methods used by various companies and industries, it was decided that the second degree curves were the most satisfactory for body plan development. Main advantages: They are very flexible, definite and easily controlled, easy to construct mechanically, and obtained with minimum of information.

Second degree curves are established by certain longitudinal lines, as will be brought out in a later paragraph. The fairing of these lines is where the graphical calculus is applied. So it is the combination of the second degree curves for body plan and the use of graphical calculus for certain longitudinal lines that we have found to be most satisfactory.

The longitudinal lines, of course, must be of the proper contour and placement to give the desired body-plan shapes which they define. This brings us to the question of what defines the second degree body plan curves.

Since, some very fine articles have been published regarding second degree curves, only a clarifying explanation

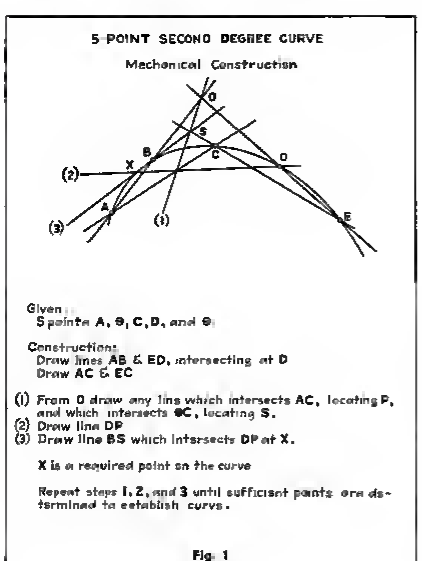


Fig. 1

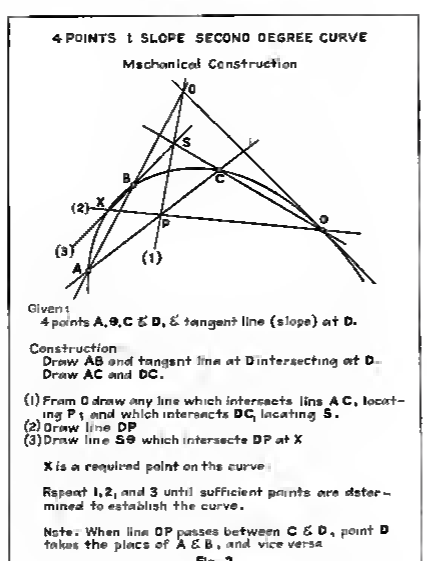


Fig. 2

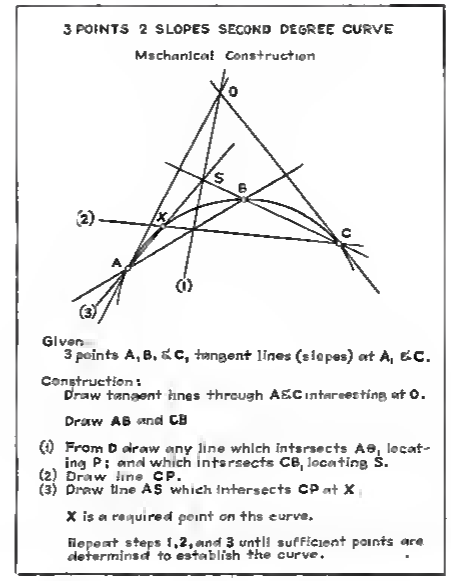


Fig. 3

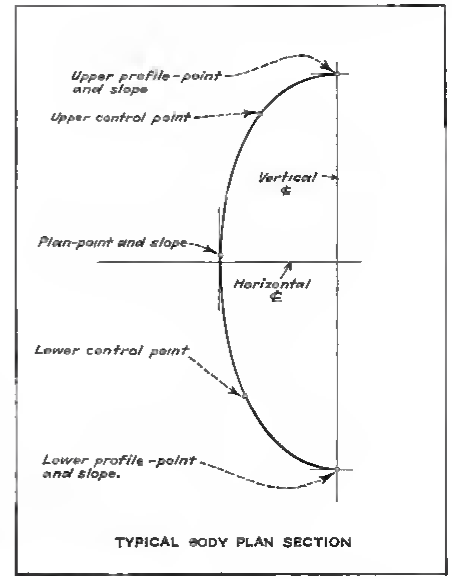


Fig. 5

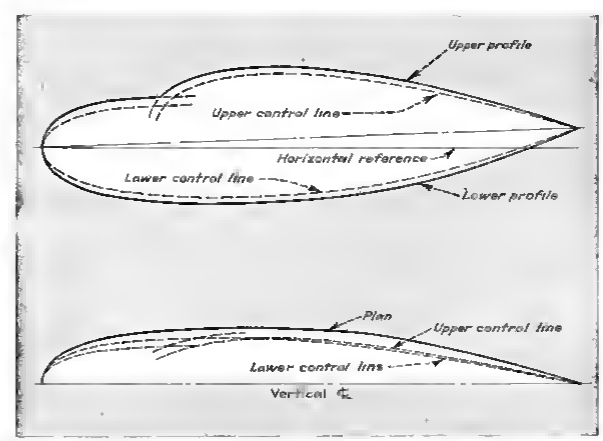
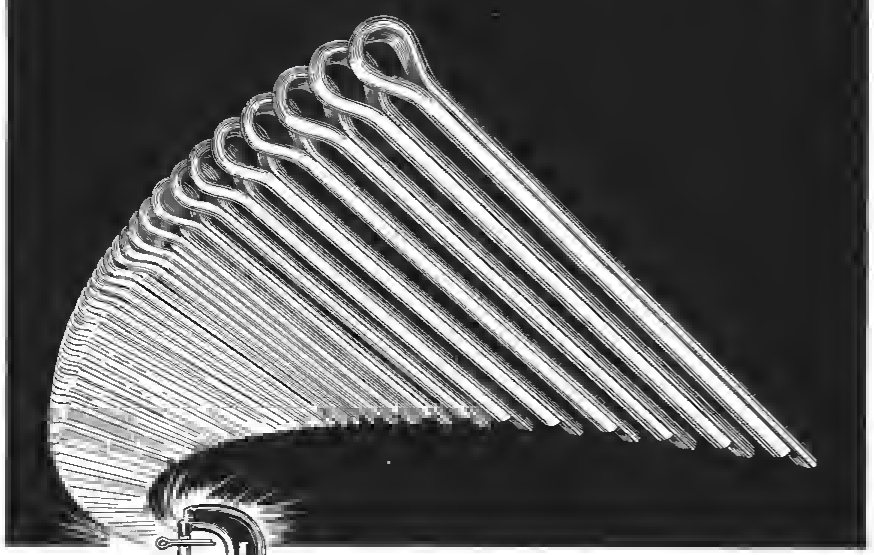


Fig. 4

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need be given here Mathematical expression of the general second degree curve is $Ax^2 + Bxy + Cy^2 + Dx + Ey + F = 0$. Or if the equation be divided through by F, the following equation results—

$$A'x^2 + B'xy + C'y^2 + D'x + E'y + 1 = 0$$

The above equation shows that if the five constants A', B', C', D', and E' are determined, then the curve is established In other words, if five conditions are established, the curve is established In general lofting practice the five conditions are either five points, four points and one slope, or three points and two slopes

Since there is a mechanical construction for each of the above three combinations, we have found it impractical to develop the mathematical equations of the body plan curves, except in isolated cases The mechanical constructions are shown here in Figs. 1, 2, and 3

For a hypothetical case, let us assume that the body plan curves are to be of the three-point two slope type, a typical body plan being shown in Fig 5 Application of the other types would be similar. Observe that each body plan consists of two second degree curves, one above and one below the maximum half-breadth Each curve is established by a point on the vertical CL and tangent to a horizontal line at that point, by a control point, and by a maximum half-breadth point and tangent to a vertical line at that point (note that the point at maximum half breadth is the same for both curves)

Begin development by mechanically fitting second degree curves to the important body-plan contours furnished by the engineering design department. The fitting is accomplished by assuming five conditions from the given curve, constructing the second degree curve satisfying these five conditions, and seeing if it closely duplicates the given curve. If the constructed curve is not satisfactory, revise the five conditions until a satisfactory curve is obtained. Curves should be established at enough stations to set up the fuselage. After the contours are determined, similar controlling conditions for each station should be established.

If similar body-plan control points be connected longitudinally with lines and if the longitudinal lines are fair then the body itself will be fair

Longitudinal lines, in our case, will consist of a line through the upper vertical CL points (upper profile), a line through the upper control points upper control line), a line through the maximum half-breadth points (plan), a line through the lower control points (lower control line), and a line through the lower vertical CL points (lower profile)

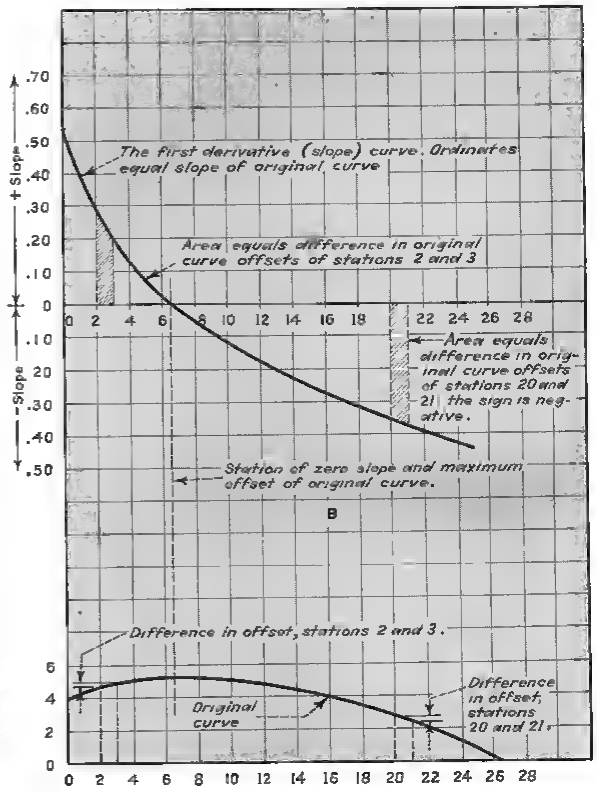


Fig. 6 A

Upper profile, lower profile, and plan-view lines are usually determined from the offsets furnished by the engineering design department, the loft department performing a fairing operation only The fairing is done by graphical calculus General contour and placement of the upper and lower control lines are determined from the fitted body plan curves Since this is the step in which the shape of the unit is determined, there will be a certain amount of working between the proposed body plan and the control lines until their interrelation gives the desired result

Special care must be taken in the area of distinct changes of contour, such as enclosures. However, the control lines in these areas can be worked out quite readily if a little ingenuity is applied After the control line is roughly determined, it is faired by the application of graphical calculus It is desirable to keep the control line a plane curve so that it need be faired only in its plane In cases where the control line becomes a skewed curve it must be faired in its plan and profile projections.

As already brought out, after the longitudinal lines are faired, the body-plan lines are an automatic construction Location of the points which determine the body plan contours are obtained from the results of the graphical calculus fairing. Note that the body-plan lines used to establish the control lines will probably change slightly in their final shape, since the control lines have been altered slightly in the fairing process

Now that we have determined which lines we will fair by the graphical calculus, let us proceed to an explana-

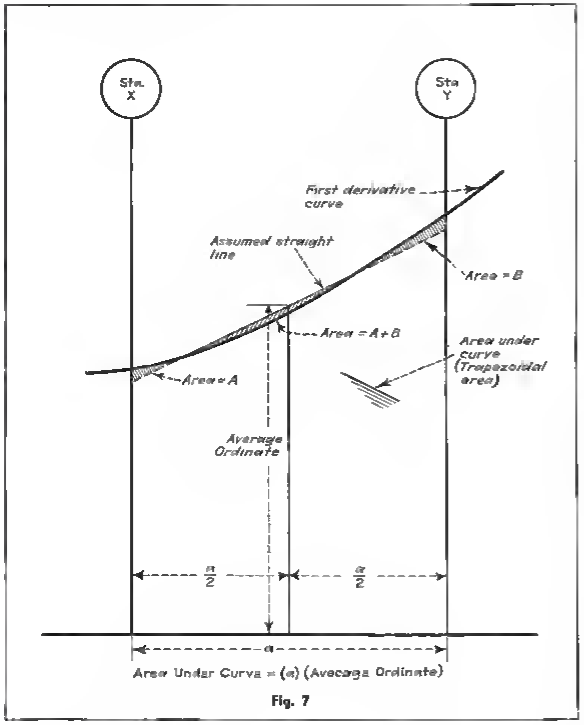


Fig. 7

tion of the method itself.

Three fundamental steps are taken to fair a line by the use of graphical calculus. First, a line of the desired shape is laid down on graph paper. Second, the slope of the curve at various stations is measured and plotted, and a line faired through these slope points, the resulting curve being the first derivative curve. Third, the first derivative curve is integrated mechanically by summing up the area contained under the curve, the summation giving the corrected ordinates of the original curve.

Expansion of the Three Fundamental Steps

First Step—Laying Down of the Original Curve. The line to be faired is laid down to scale on graph paper. It is usually convenient to put the control lines directly on the graph paper when in the aforementioned "working between" stage in order to eliminate duplication of work.

The scale is dependent upon the size of the fairing to be done, however the average sheet of graph paper should be about 2x5 ft. A good graph paper is K & E 282G, 24-in. width, 10x10 to the inch, 5th line heavy. This paper is obtained in 50 yd rolls.

Fig. 6A is an example of the original curve laid down on graph paper. Any major unfairness of the curve is obvious in its scale layout and should be corrected before step two is started.

Second Step—Obtaining the First Derivative Curve. The slope values at convenient stations of the original curve are now obtained and plotted. Slope values are plotted as ordinates to a greatly expanded ordinate scale but against an abscissa scale which is the same as that for the original curve. Expansion of the ordinate scale is what determines the resulting accuracy and should be such that 0.001 in. is readable, for example, 1 in.=0.050.

Now fair a curve through the plotted slope values, holding as close as practical by eye to the mean average of the points. The resulting curve should be continuous and without reverse, unless such conditions are used to obtain a desired result. This operation is the

(*Turn to page 349*)

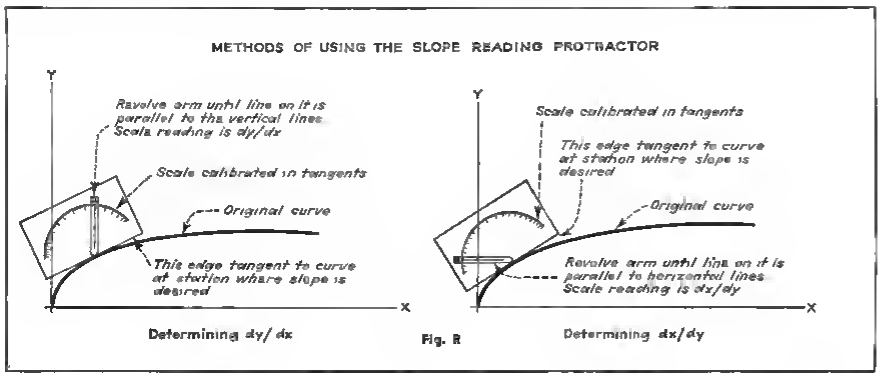


Fig. 8

More From Your Drop Hammers

By CHRIS J. FREY, *Brewster Aeronautical Corp. and*
STANLEY S. KOGUT, *Eastern Aircraft Production Forum*

Concluding a series devoted to drop hammer technique and innovations, the authors here describe proper set-up procedures and give some more tips on the making of dies and uses of rubber.

THE PUNCH IS SET on the die and both are placed on the bed of the hammer for mounting together. If removable studs have been used in the punch, they are screwed back into the nuts left in the punch for that purpose. The dies are then shifted around so that the bolts of the punch are in alignment with the holes in the hammer head. The hammer is then lowered and the punch bolted into place. Since the location of the female is governed by that of the punch, it must be fastened without disturbing its position. After fastening the punch, raising and dropping it several times insures the correct position of the female.

Wet clay should be wiped around the base of the female die to keep the lead used in fastening it to the anvil from adhering to it and contaminating it. Four tapered metal blocks are screwed onto the anvil, and a frame, made out of iron or wood is placed around the whole set-up. Two clay dams should be built from the base of the die to the frame, preferably on opposite sides of the die. Purpose of these clay dams is to facilitate removal of the die from the anvil when the time comes. The entire frame is then filled with molten lead. When the lead solidifies it holds the die securely on the anvil.

By destroying the clay dams, removal of the lead and then the die from the anvil is comparatively simple. Unless such a provision is made, the lead must be cut away.

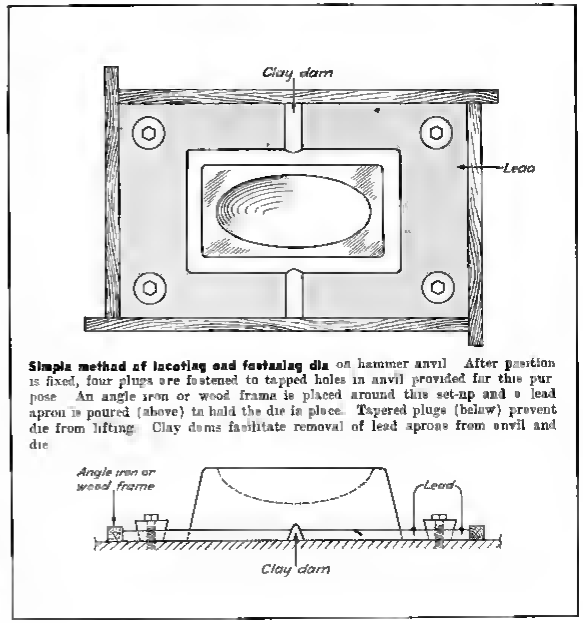
An alternate method of fastening the dies is to use clamping lugs, cast integrally with the dies while at the foundry. For this method, tapped holes must be provided in the base of the anvil. Clamps are then used to attach the die to the anvil by means of cap screws. The hold down ends of the clamps are thus braced firmly against the clamping lugs on the die.

There is a very simple and reliable method used to determine the correct shape of contour of a blank out of which a part can be hammered. The dies to be used are set-up in the hammer and they are wiped with oil. Use a piece of heavy brown paper as if it were a sheet out of which the part was being stamped. The wrinkles and lapping shown on the paper are a reasonably accurate indication of the amount of stretching or shrinking that will take place. Cut around the oil marks to get the shape of the first blank. This will give a good working start, although slight changes will have to be made in some cases.

Templates are then cut out on a band saw, or if the sides are straight, they may be cut on shears. Dies may then be marked with paint for locating templates on the dies before striking.

How Rubber Is Used

There are two distinct uses for rubber in drop hammer work. One is for draw rings to restrain the sheet, and the other is as a means to localize the blow on any desired area. (AVIATION, Oct., 1942: Drop Hammer Technique and Innovations). Until recently, the same material was used for both operations. This was a high quality stock with a tensile strength of 4,000 to



Simple method of locating and fastening die on hammer anvil. After position is fixed, four plugs are fastened to tapped holes in anvil provided for this purpose. An angle iron or wood frame is placed around this set-up and a lead apron is poured (above) to hold the die in place. Tapered plugs (below) prevent die from lifting. Clay dams facilitate removal of lead aprons from anvil and die.

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4,400 psi. (Tensile is the force—in pounds—necessary to pull apart a square inch of rubber). It has high elongation and is used in various thicknesses according to the operation for which it is intended. It is used in hardnesses ranging from 45 durometer, to 60 durometer, depending on the particular operator rather than anything else. This type of material has a reasonably long life, considering the rigorous use to which it is put. Its high tensile makes for great resistance to tearing, but once it does shred it is relegated to the scrap heap. It is very firm to the touch and springs back to position quickly when distorted because of its great resistance to permanent set. It stores up energy and has a tremendous kickback when struck by a hammer blow. This type of stock is rich in rubber content and expensive.

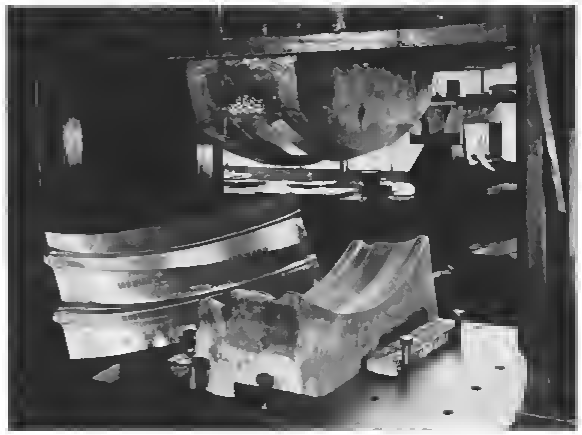
A new type of rubber has entered the field and has met with wide approval as a means for localizing the blow on the sheet being hammered. However, it cannot be used for draw rings. This material is sometimes marketed as a special drop hammer stock at fancy prices. The material is actually a good grade of unvulcanized reclaim, relatively inexpensive as compared with pure gum stocks. Standard size is approximately 24x24x1 in. That is the size in which reclaim is sold to rubber companies by reclaimers. Actually, very few rubber companies make their own reclaim although some do control reclaiming plants. Rubber manufacturers generally purchase reclaimable rubber for their own processing requirements.

Drop hammer stock needs no processing. It is sold and delivered to the hammer operator with no additional processing.

This type of material is very soft and inclined to be tacky. It flows easily and has little resistance to permanent set. It does not store up energy and hence does not kick back. It will shred and fall apart infinitely easier than rubber as we have previously known it for drop hammers, but with a little effort it can be made into a mass again. Freshly torn surfaces will adhere to each other without difficulty.

Some operators prefer to accumulate the pieces. Then they dampen them with naphtha, benzol, or gasoline. This will remove the dirt and then by the application of pressure, the material will become a solid mass and be ready for use again. These same solutions can be used to ply the material up to any desired thickness.

The standard piece of 24x24x1 in. weighs about 26¼ lb. Reclaim is obtainable without any difficulty, whereas the same cannot be said of rubber. It offers a patriotic means of conserving rubber. Experiments are now being made with pliable plastic materials that may be used for this purpose instead of rubber.



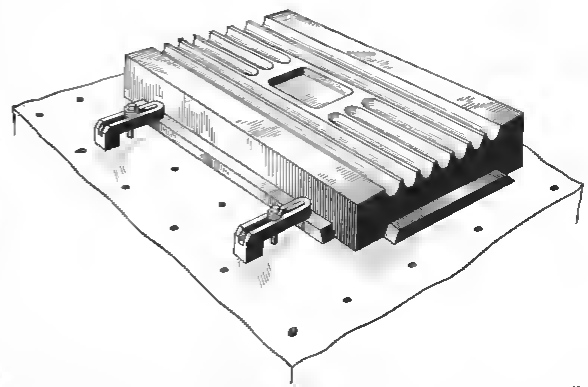
An example of haphazard and inefficient method of setting up a die. It can result not only in spoiled parts but also in damage to tools and injury to operators.

Under varying impacts, rubber acts differently. It is not unusual to find that by reducing or increasing the force of the hammer head blow upon rubber a part can be made that otherwise could not. If it appears that a logical approach is being made to the forming of a part, but the sheet does not seem to flow accurately into the desired shape, experimentation to find the effects of a more or less forceful blow, or a series of blows, will often yield the solution. Rubber actually performs differently under varying impacts. It is generally accepted that the use of rubber in a hammer makes for greater wear on it.

Making the Punch

While there are some rare occasions when the female die is referred to as the punch, this is the exception rather than the rule. Unless there is some qualification, the male die is the punch.

Lead is almost universally used as the punch material, and to it a small amount of antimony is added so as to impart additional hardness, since lead wrinkles and marks easily in its



When clamping legs are cast integrally with the die, hammer set up is greatly simplified. Sketch shows how clamps hold die in position by means of cap screws inserted in holes tapped in anvil for that purpose.

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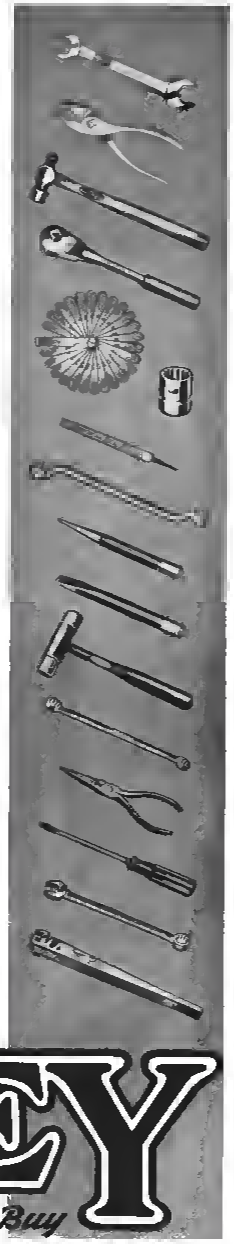
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pure state. The exact amount of antimony added is one of personal preference. Although antimony does make the punch harder, it also reduces its ductility. The generally accepted practice, therefore, is to add from 5 to 10 percent antimony to the lead punch.

Pure lead has a tensile strength of 1,780 psi. which is increased to 6,000 psi. by the addition of 5 percent antimony, and to 7,600 psi. by adding 10 percent antimony. The melting point of pure lead is reduced from 621 deg. F. to about 550 deg. with a 5 percent antimony content, decreasing to 495 deg. with a 10 percent antimony content. However, the corresponding decrease in ductility is so great that it often is extremely undesirable to increase the antimony content beyond 10 percent.

Current procedure used in making the lead punch is to place the female die, of either zinc, zinc alloy, or cast iron, on a perfectly level bench or floor. An adjustable steel form is placed around the die and fastened by driving in wedges, the form extending to at least 3 in. above the highest part of the die. All seams in the form, or between the form and the die, are packed solidly with clay or sand to prevent the molten lead from running out when it is poured.

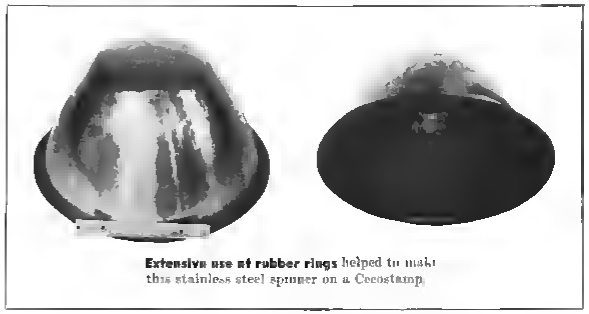
There was a time when the lead pouring operation took place directly on the anvil of the hammer with the bolts hung into the hammer head itself. It is, however, essential to wait for the metal to set after the pouring, and in this method the hammer remains idle for the setting period, a circumstance which does not meet with approval in these days of all out production.

As is the case with the female die, the metal used in the punch can be melted and recast, but it should be analyzed frequently because the antimony content tends to depreciate. The metal in the pot should be cleaned occasionally and the surface dross skimmed off, using sal-ammoniac as the cleaning agent.

Having prepared the form around the die and packed the seams, the die itself should then be heated to prevent cold shutting, which is a cause of rough surfaces. This preheating can be done either by using a standard torch or by pouring a ladleful of lead into the die, permitting the lead to remain there until it solidifies, and then removing it just before the actual pouring for the punch.

Another step prior to the pouring is the preparation of a fixture which will provide for spacing bolts in the punch so that they conform to holes in the hammer head. This fixture is placed on top of the steel form around the die, and when the metal has been poured it serves as a means of locating studs with attached nuts which are inserted into the molten mass. The studs should be ☆ in. oversize and should be coated with graphite.

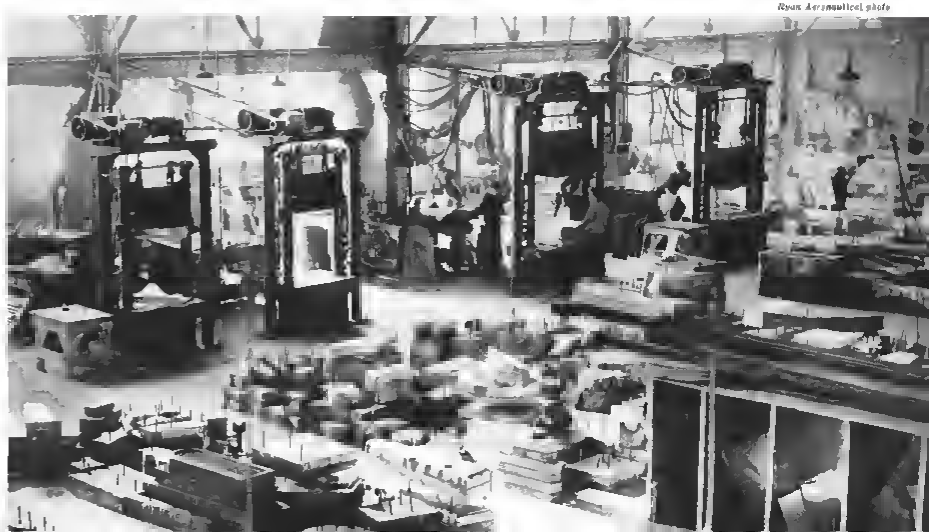
When the metal has solidified the studs are removed, leaving the nuts solidly embedded in the punch so they can be used subsequently for fastening.



Extensive use of rubber rings helped to make this stainless steel spinner on a Cecostamp.

Casting of studs integrally with dies is a common practice, but a glance at the plant scene below demonstrates forcibly the disadvantages. With removable studs, storage of dies in a smaller area is facilitated, bending and other damage to studs is lessened, fewer studs are required.

Ryan Aeronautical photo





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the punch to the head of the hammer.

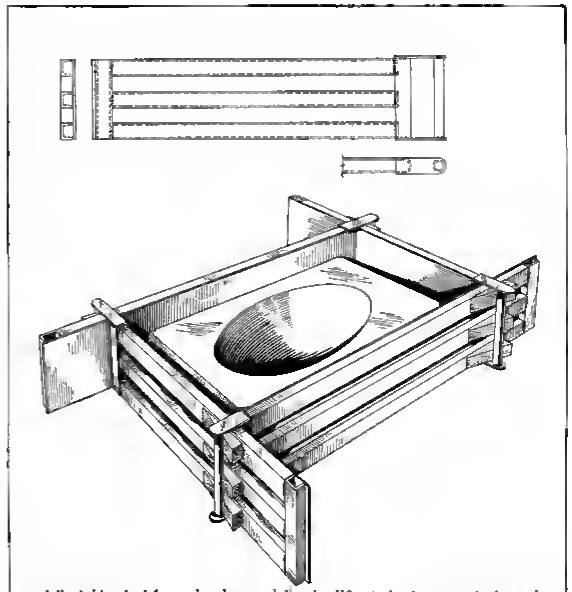
The method outlined here is not being used universally. Some drop hammer departments do not use a removable stud but leave the bolt cast directly into the punch. This latter procedure seems disadvantageous in that it requires storing an unnecessarily large number of bolts and also exposes the attaching bolts to the danger of being bent when the punch is piled in storage. On the other hand, a studless punch does have one serious drawback if extreme care is not taken. In the event that the holes left when the bolts are removed are not covered up, the recesses will make excellent places for water to accumulate should the punch be exposed to the weather. If this water is not removed prior to remelting the punch in the furnace pot, it will cause the molten lead to explode with sufficient force to severely burn men working in the immediate area.

Lead punches do not require much dressing. As soon as the lead hardens, the form is broken away and the punch is cleaned up. While there is slight solidification shrinkage, a few blows of the hammer will soon force the ductile lead to conform accurately to the shape of the female die. Under continuous and heavy hammer blows, a female die tends to distort, whereas a male punch will reseat itself with every blow of the hammer and remain accurate for a longer period of time. Since lead flows under the heavy impact of the hammer, it acts somewhat like rubber under pressure and forces the sheet being formed up against the die. The punch would soon lose its original contour if it were not confined within the female die. But every drop of the hammer into the female die causes the punch to reassume its proper shape. Even if it does not set properly before the hammer is dropped, the flowing qualities of the metal and the force of the blow will soon cause it to assume its proper shape.

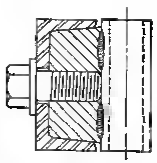
In preparing the lead punches for use, a clearance equal to the thickness of the sheet out of which the part is to be made must be scraped from the vertical sides of the punch so as to prevent the punch from jamming into the die when they are brought together.

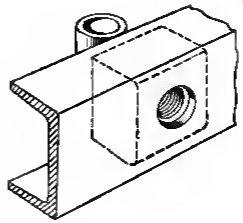
In addition, if there are cooling cracks, failure to allow this clearance will cause the die to split. Clearance is also scraped off the surface where the punch and die may hit together, pre-

(*Turn to page* 351)

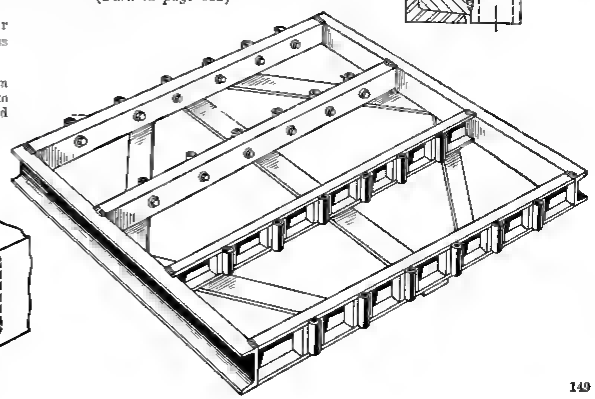


Adjustable steel form placed around die simplifies task of pouring lead punch directly into die. Sand or clay can be used to fill crevices. Sketch shows details of construction





Bolt spacing fixture for locating studs in lead punch. Hole locations correspond to tapped holes in hammer head; tubes hold studs square until lead has set



Design Considerations For Plywood Structures

Part III

By L. J. MARHOEFER
Chief Engineer Vidal Research Corporation

Continuing his discussion of basic plywood design factors for aircraft, the author here analyzes plywood structural stresses.

EFFECT OF GRAIN ANGLE was briefly mentioned in our previous installments. Becoming more specific on this point, it will be realized that a variation in modulus of elasticity of a portion of the material in a given cross section will profoundly modify the stress distribution on the section.

For greater clarity on this point, assume a non-homogeneous section in which the middle portion of a fuselage is constructed of dural while the upper and lower portions are of rubber. Calculation of the stresses in such a section must be based not only on the areas of the parts and their distance from the neutral axis but also must include the value of modulus of elasticity of the parts themselves. The formula for the moment of inertia, taking proper account of this non-homogeneity, becomes—

$$I = \Sigma\left[\frac{E_1}{E} A_1 y_1^2 + \frac{E_2}{E} A_2 y_2^2 \cdots \frac{E_n}{E} A_n y_n^2\right]$$

Where:

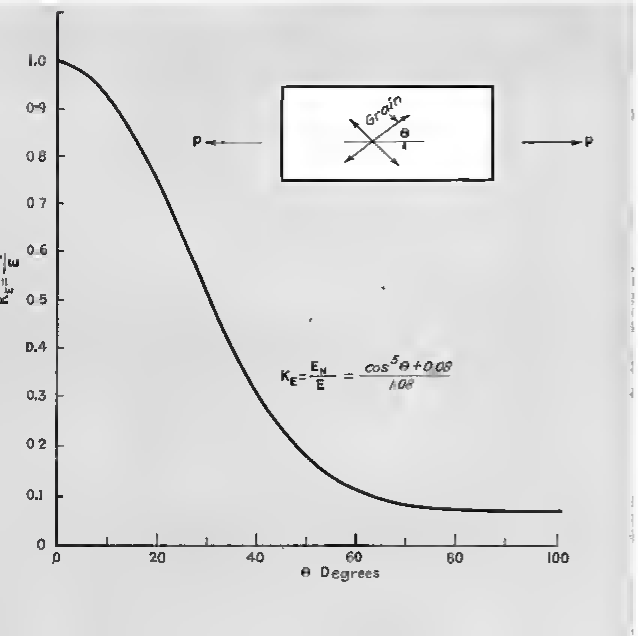
E_1, E_2 etc., are the values of E for the individual parts

E is a standard modulus of elasticity usually taken as E_{11} E_c or E_s

A_1 A_2, etc. are the areas of the elements of the fuselage

y_1 y_2 are the distances from the neutral axis of the section to the centroid of the elements

Fig. 1. Relative modulus of elasticity vs. grain angle—plywood



Plywood Values of E

Tests on plywood with various grain angles to the direction of load have demonstrated that the effect of grain angle is pronounced and must be considered in calculating fuselage section properties. Fig. 1 (variation of E with grain angle) is presented as at least a start toward the evaluation of such data. Background of this curve is a series of tests at grain angle 45 deg plus the known values of E for grain angles at 0 and 90 deg. to the load. The curve is based on the formula—

$$K_E = \frac{E_n}{E} = \frac{\cos^5\theta + .08}{1.08}$$

which, in addition to meeting the above requirements, is recurrent.

Effective Width of Stiffened Shell

Another effect, which will occur immediately to those familiar with metal monocoque practice, is the determination of the proper width of plate to include with the stiffeners in calculating section properties. This "effective" width will not only vary with the stringer stress but will also require evaluation of the effect of the curvature of the panel (r/t). The proper allowances are not determined as yet for either variable, and design has necessarily been dependent on the optimism of the different organizations. Error introduced by improper "effective" width is minimized where the grain angle of the shell is approximately 45 deg. since E_n/E is then quite low and renders any chosen value of plate width relatively insignificant. For 45-deg. veneers, values of "w" = $12/t$ each side of the stiffener plus the skin over the stiffener itself have been used by the writer without serious embarrassment.

In order to clarify the above discussion, a typical fuselage shell section is shown in Fig. 2, where the various effective widths are indicated. Note that as in metal monocoque practice the compression side of the section must be defined, and "effective widths" of plating are used only on the portions on the compression side of the neutral axis. Again, as in metal practice, some judgment is required as to the location of the neutral axis and the estimation of the plate stresses in the vicinity of the neutral axis in order to determine a proper effective width. Fortunately, the weight loss due to conservative estimates on these points is small, for the doubtful widths are close to the neutral axis. The table is included as a typical calculation of this section.

Compressive Bending Stresses

Bending stress in the extreme compression stringer, A is computed from the familiar My/I formula. For an assumed bending movement of 250,000 in. on this section, the stress on the stringer will be 2,500 psi. Assuming a 20 in. frame spacing, the L/C of the stringer-plate combination is computed as follows:

$I = .0871$
$A = 1.595$
$C = 2.33$

$$\frac{L^1}{C} = \frac{20}{.233} = 86 \text{ for } C = 1.0 \quad F_c = 1750$$

$$\frac{L^1}{C} = \frac{86}{\sqrt{2}} = 61 \text{ for } C = 2.0 \quad F_c = 3200$$

$$\frac{L^1}{C} = \frac{86}{\sqrt{4}} = 34 \text{ for } C = 4.0 \quad F_c = 4400$$

The above values of F_c, the allowable compressive stress, are taken from ANC-5 Figure 2-1. Of the above stress values, a fixity coefficient of 2 is most likely to be reached in test. Tests on fuselages have indicated that a good fixity and high value of stress may be expected in this type construction. It is regrettable that more data on compressive allowables is not at hand, but in an effort to account for the good values of compressive stress so far obtained, the following points might be considered:

The molded monocoque shell has inherently, and without frames, a rigidity not found in bent plywood or sheet metal. This ring rigidity can have a decided supporting effect on the stringers, which would be evidenced by the tendency of the compressive stringers to carry loads beyond those which might normally be expected. Amount of rigidity necessary to provide this support is not readily determined but as section moduli or rupture data are obtained, it may be possible to evaluate the amount of support provided by the shell from the stress at failure on compression stringers.

Another possible and perhaps more likely explanation is that the effective width of shell-plate and the effective value of E as determined from tensile tests are too low. In favor of increased effective plate width is the visual evidence during tests which indicate compression wrinkles do not form as quickly as might be expected. Proper evaluation of compressive E vs. grain angle by "pack-compression" test, or

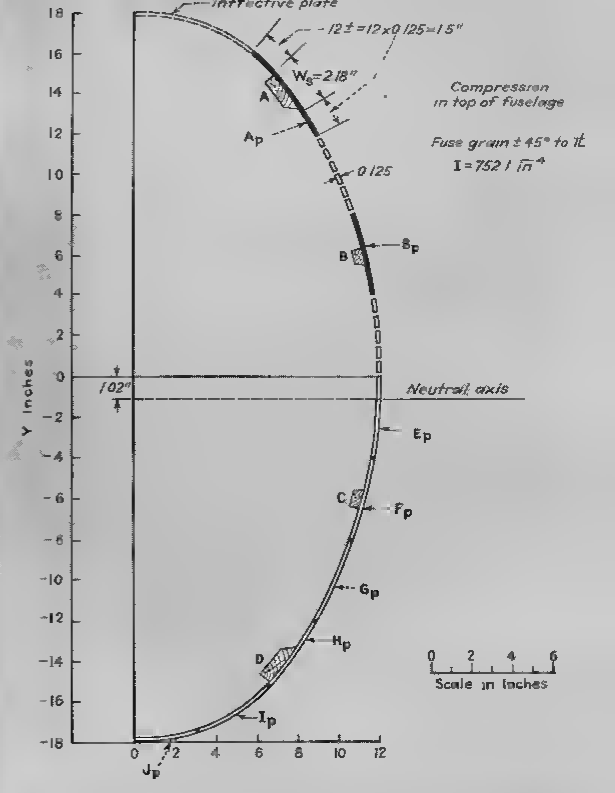


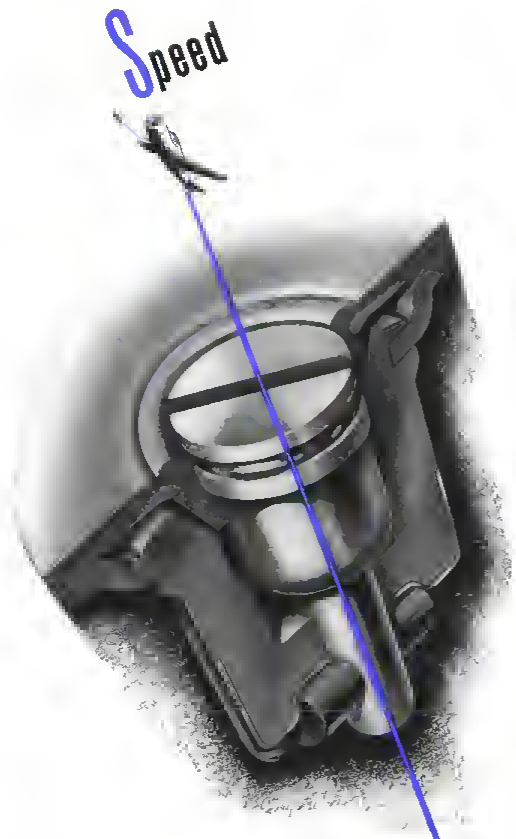
Fig. 2, Stress calculations for a typical fuselage section

1	2	3	4	5	6	7	8	9	10	11
Item	Length (Fig 3)	Thickness (Fig 3)	Area (②×③)	K_E (Fig 2)	$A_E = A K_E$ (④×⑤)	F (Fig. 4)	A_y (⑤×⑦)	I_o (⑦−$\bar{y}$)	$A_y\bar{y}$ (⑧×⑨)	$A_y\bar{y}^2$ (⑧×⑨²)
1	2	75	1.5	1.00	1.500	14	21.00	15.02	22.6	340.0
A_p	5.18	125	.646	23	148	14.2	2.10	15.22	2.25	34.3
B	75	50	.375	1.00	.375	8.8	2.25	7.02	2.63	18.4
B_p	4.6	125	50	23	115	8.8	60	7.02	861	5.7
E_p	4.6	125	50	23	115	−2.8	− 32	− 9.8	− 13	1
F_p	4.1	125	.513	23	118	−6.0	− 71	−4.98	− 59	2.9
C	.75	.50	.375	1.00	.375	−8.0	−3.25	−4.98	−1.87	9.3
G_p	4.2	125	.525	23	121	−10.0	−1.21	−8.98	−1.09	9.8
H_p	4.0	12n	500	23	115	−13.5	−1.55	−12.48	−1.43	17.8
D	2.0	75	1.500	1.00	1.500	−14.5	−21.30	−13.18	−10.75	260.0
I_p	4.n	125	500	23	115	−16.5	−1.90	−15.48	−1.78	27.6
J_p	3.26	12n	406	23	093	−17.8	−1.66	−16.78	−1.66	28.2
Σ					4.689		−4.77		−0.11	732.1

$$\bar{y} = \frac{\Sigma A_y}{\Sigma A_E} = \frac{-4.77}{4.69} = -1.02$$

$$I = 752.1 \text{ in.}^4$$

Note: Moment of inertia of the items about their own axis is small and may be neglected for the purpose of this discussion.



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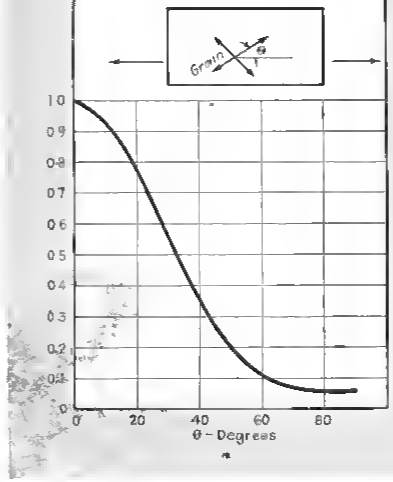


Fig. 3. Tensile strength vs. grain angle—plywood

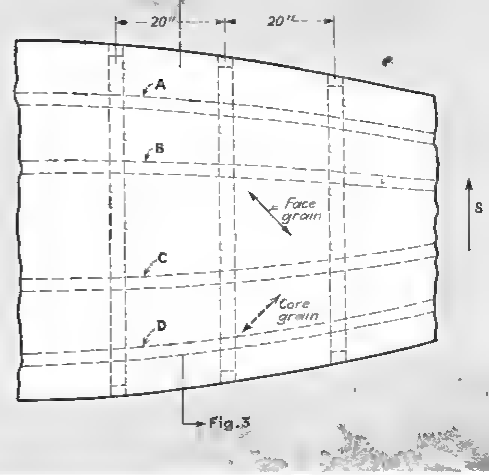


Fig. 4. Shear stresses in a typical fuselage section of conventional construction

other similar means, is highly desirable.

Examining the next compression stringer, B, the stress under the same bending moment is 995 psi. Ignoring the effective plating, the $\frac{I'}{C}$ is 138 for $c = 1$ and 691 for $c = 4$, with corresponding allowable stresses of 700 psi and 2,250 psi. Again the probability of failure is not clearly defined for the reasons mentioned in connection with stringer A. Likelihood of the skin buckling under load is greater due to the higher shear stress encountered in the vicinity of the neutral axis and the question as to the proper amount of effective plate is reduced. The low stress in this instance, however, indicates this stringer would not fail before stringer A.

Tension Stresses

Behavior of tension material in both wing and fuselage has been somewhat more difficult to understand and explain than the compression material. Whereas the compression material has almost invariably exceeded the expected stresses the tension fibers have compensated by not living up to the handbook values. This fact is responsible for the dearth of information on compression failures and allowable compressive stresses in actual tests. The possibility that the effect of grain angle was the source of trouble led to investigation of the tensile strength variation with grain angle.

The results of this investigation are presented in Fig. 3. Actual values have been reduced to a function of the standard tensile strength parallel to the grain to facilitate use with various woods. Tests for this curve were obtained from mahogany specimens with grain angles of 30, 45 and 90 deg. It might be noted that the curve matches closely the formula for effective modulus of elasticity.

Returning to the stresses on the example section the tension stress on skin item J_2 is—

$$F = \frac{My}{I} = 250{,}000 \times \frac{16.78}{1{,}504} = 2{,}780 \text{ psi}$$

Correcting this value for the value of K_g the actual stress will become—

$$F' = 2780 \times .23 = 640 \text{ psi}$$

This stress is conservative and, in fact, no skin failures have occurred in similar regions under test, except where openings and cutouts with inadequate framing were present.

Tension Stringer Stresses

Examining next into the stress in stringer D—

$$F = \frac{250{,}000 \times 13.18}{1{,}504} = 2{,}190 \text{ psi}$$

Using standard handbook values for spruce, this stringer is oversize and should have a margin of safety of 350 percent. Tension stresses achieved under static test do not agree with this margin. The search for a rational explanation of failures, which in early structures were, with one exception, all tension failures, produced the basic information presented in Figs. 1 and 3. Recalculation of sections at points of structural failure indicated that even these reductions were not sufficient, and at the present time an arbitrary maximum value of 5,000 psi. tension stress is used in combination with the calculation of section properties shown in the table in Fig. 2. The method is admittedly full of uncertainties and is not thoroughly checked by test, but it does have the advantage of predicting failures within ±10 percent, which approximates the expectancy of wood as a material.

The above values and remarks are applicable to sections other than those for which form factors have been developed. Tests on standard I- and box-beams, as developed by the Forest Products Laboratory have agreed remarkably well with the values predicted by the standard charts for both tension and compression allowables. A well-founded explanation is not developed of the discrepancy when beams are not amenable to the standard investigation for modulus of rupture.

Shear Stress

Turning next to the shear stress, which the example section may be expected to develop, it is apparent that the maximum stress will occur at the neutral axis, since the shell is of uniform thickness. The shear at any point may be computed from—

$$f_s = \frac{SQ}{bI} = \text{Shear stress psi}$$

where:

S = Transverse shear on the section

$Q = \Sigma A_e$ or the static moment of the area above the point about the neutral axis

b = Shell thickness

I = Section moment of inertia

(*Turn to page* 348)



New propeller with a Destiny

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Propeller Division, Wickwire Spencer Steel Company, 500 Fifth Avenue, New York City.

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FACTORY MAINTENANCE

Maintenance of Battery-Powered Plant Trucks

By F. L. SAHLMANN

Transportation Department, General Electric Company

Preventive maintenance is the keynote in these steps which should be taken to avoid costly breakdowns and replacements in battery-powered trucks which play such an important part in aircraft production.

BATTERY-POWERED industrial trucks, possibly because of their ability to operate longer without proper maintenance than most similar equipment, are often neglected to the point where their normal span of usefulness is seriously impaired before they are, finally, inspected and overhauled.

Today, such negligence is inexcusable, since during no previous emergency in the country's history have conditions necessitated such rigid maintenance of industrial equipment as now. Regular inspection and overhauling are the only positive guarantees of the continuous, efficient performance demanded by the 24-hr-a-day, 7-day-a-week production schedules now so common.

Following are suggestions designed to facilitate the care and maintenance of the electrical units of these important pieces of equipment.

General Precautions

The batteries, sole source of propulsive energy, should be inspected and serviced at regular intervals, according to the recommendations of the battery manufacturers. And replacements should be made without delay.

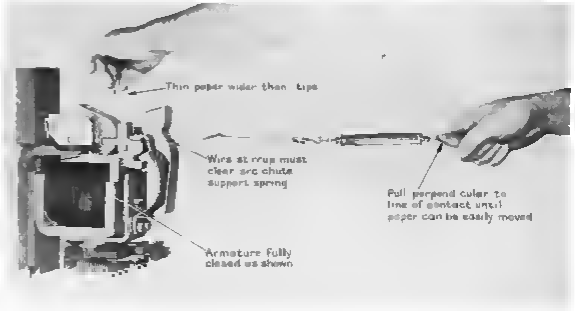
Both the traction motor, which propels the truck, and the hoist motor, which drives the pump on trucks equipped with hydraulically operated hoist and tilt mechanisms, or the gear box on gear or chain drive hoist and tilt mechanisms, should be inspected monthly and overhauled approximately once a year.

The controller, the commutator, the contactor, the accelerating resistor, and all allied parts, should also be inspected and overhauled at like intervals. Naturally, local conditions and the skill of the operator will dictate the frequency of inspection and overhaul.

Suggested procedures follow.



Fork-equipped, battery operated truck making a 11-ft. lift.



Method of measuring final contact tip pressure on a magnetic contactor.

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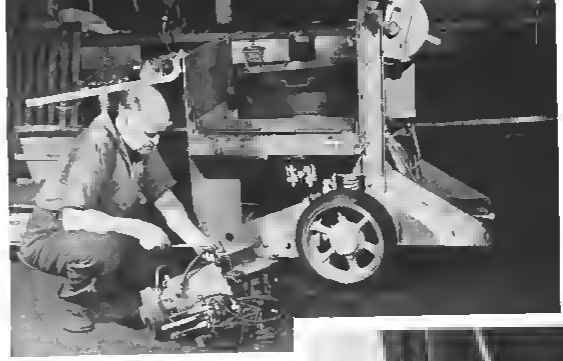
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ROMEC PUMP COMPANY

ELYRIA, OHIO, U. S. A.



Tilt mator removed for inspection and servicing

FACTORY MAINTENANCE

Adjasting brushes while servicing tilt motor.



Assembling tilt motor after servicing

Monthly Inspection

1 Remove dirt from commutator cover and surrounding parts to prevent it from falling into the motor

2 Remove commutator cover and examine mechanism See that copper surface has a smooth, polished appearance and is free of copper beads and grease.

3 See that the brush holder mechanisms seat on brushes and that shunts and terminals are tight.

4 Wipe carbon dust from cables and brush holders

5 Remove dirt from brushes by lifting springs and raising and lowering brushes in the carbon ways. Do not snap the springs, because this may chip the brushes.

6. Replace short or broken brushes with new ones of the proper grade If only partial replacement is made, grind new brushes to same length as the other brushes in the motor.

7 Inspect connections for tightness.

8 Examine the interior of motor for charred or broken insulation or other injuries Replace damaged parts

9. Replace commutator cover

Annual Overhauling

1 Remove motor from truck and clean outside of it

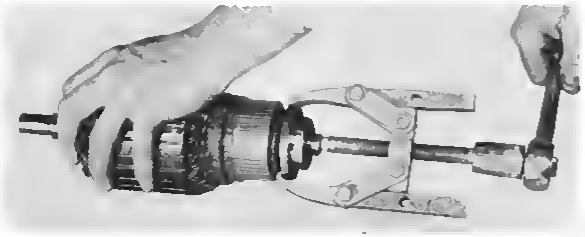
2 Remove commutator cover and raise the brushes from the commutator to avoid damaging them

3 Remove the nuts from the studs at the pinion end of motor and withdraw the armature complete with commutator-end bearing assembly and pinion end frame-head assembly through pinion end.

Important: To obtain maximum life from bearings, they must be kept free of dirt Therefore, when bearing assemblies are removed from motor, keep them covered

4 Remove the pinion end framehead assembly and commutator-end bearing assembly from armature, employing suitable puller





Front-end ball bearing being removed from armature with hook type puller

5 Blow out dust and dirt from armature, using clean *dry* compressed air and wipe clean of oil and grease with a cloth saturated with carbon tetrachloride

6 If armature is found in good condition, proceed as follows:

7 Bake at least 12 hr. at 120 deg. C. (250 deg. F.).

8 While hot, paint with a varnish. Paint the string beads, but take care to keep the commutator clean.

9 Bake for 12 hr. at 120 deg. C. (250 deg. F.).

Note: If it is found necessary to remove armature coils because of grounds, short circuits, or other damage, it is recommended that the complete armature be sent to the nearest service shop for repairs and rewinding.

Checking operation of tilt motor clutch



10 Take out the cap screws at the commutator end and remove the frame-head.

11 Blow out the interior of motor with clean *dry* compressed air and wipe clean of any oil and grease with carbon tetrachloride.

12 If field coils are tight and in good condition, paint them with varnish. Also, paint the interior of the motor with varnish, using care not to get any varnish on the pole-piece faces. Otherwise, remove field coil as follows: Disconnect the cables and remove the cap screws holding field piece to frame. Then slide out the pole and coil through end of frame and slip coil off pole. Keep each pole, coil, and any accompanying shims, together. Upon reassembly, take care parts are returned to their original position, use new lock washers with pole piece cap screws, make sure that contact surfaces are clean, cables are properly reconnected, and cap screws drawn up tightly. Check the coil polarity. Guard against loose connections at all times.

13 Remove dust and dirt from brush holders and cables with carbon tetrachloride.

14 See that brush-holder mechanisms operate properly, that brushes are free in carbon ways, that shunts and terminals are tight, and that carbon ways are not rough or worn. Brushes should never be allowed to wear so short that the pressure arm of the lever rests on the top of the brush-holder carbon way instead of on top of the brush. All brushes must have the same length to obtain an even distribution of current.

Note: New brushes may be fitted to the commutator brush holder by placing a strip of fine sandpaper between the end of the brush and the commutator, with the rough side of the sandpaper against the brush.

15 Pole-piece cap screws must be tight and locked with lock washers.

16 Reassemble parts on armature. When replacing bearings, use a suitable brass sleeve so that the pressure will be on the inner race of the bearings.

17 Reassemble armature in frame, putting in new brushes if necessary.

The Commutator

Never lubricate the commutator, since the brushes contain sufficient lubrication. A dirty and greasy commutator will collect carbon dust in the grooves between the segments. This condition will cause a short circuit. The commutator should be kept smooth and concentric with the armature bearings. If the

(*Turn to page* 323)



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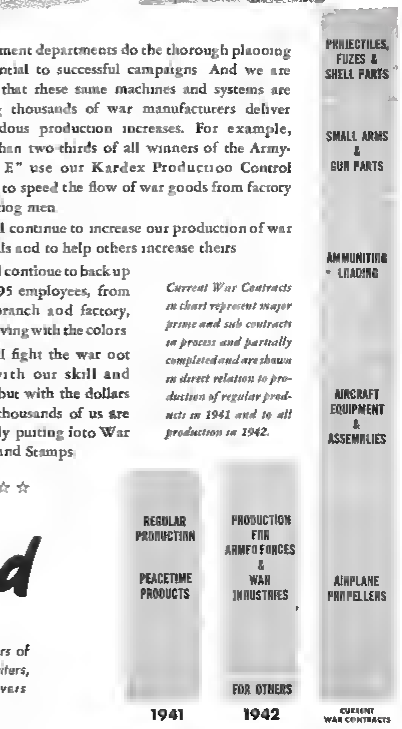
We are proud of our production of weapons and war equipment. We are equally proud that the typewriters, business machines and control systems we normally make are helping the armed forces and government departments do the thorough planning so essential to successful campaigns. And we are proud that these same machines and systems are helping thousands of war manufacturers deliver tremendous production increases. For example, more than two-thirds of all winners of the Army-Navy "E" use our Kardex Production Control System to speed the flow of war goods from factory to fighting men.

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We will fight the war not only with our skill and ability but with the dollars which thousands of us are regularly putting into War Bonds and Stamps.

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Applications for Thermex.

Power Flow Diagram of Thermex.

Rapid, uniform heating regardless of thickness!



In the manufacture of sections and assemblies for wood planes and gliders, Thermex reduces bonding time from hours to *minutes*, insures *uniform heating* throughout, and practically *eliminates rejections.*

Both builders and sub-contractors are urged to investigate the many advantages of Thermex high frequency electrostatic equipment which generates heat *within* non-metallic materials by setting up molecular friction.

In making propellers, spars, ribs of both solid web and truss construction, wing and fuselage covering, bomb bay doors, ailerons, nacelles and other parts, Thermex can effect a tremendous saving in time and labor, in addition to doing a better job.

Find out how easy it is to apply Thermex to your present operations. Write for a new booklet fully describing Thermex and its many uses. Mail the convenient coupon *now!*

■ A few advantages of Thermex high frequency electrostatic heating equipment:

Uniform heating throughout. Speed of heating never before attained. Applies to all non-metallic materials. No misdistribution of moisture. Less handling required. Reduces labor cost. Handles wide variety of jobs with high efficiency. Results may be reproduced without variation. No surface damage or danger of overheating. Heating may be suspended immediately. No "hot plates" or steam required. Wide range of sizes for all needs.

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The **GIRDLER CORPORATION**

Thermex High Frequency Electrostatic Heating Equipment

THERMEX DIVISION . LOUISVILLE, KENTUCKY

Vultee Flight Test Recorder

A radio flight test recorder has been perfected by engineers of Vultee Aircraft, Inc., and is to be made available to the entire aircraft industry. Composed of two main units one for temporary installation in the plane to be tested, and the other to remain on the ground, the new device broadcasts a continuous flow of vital information desired by design engineers.

Small enough and so light it can be easily installed in a trainer or pursuit ship, the apparatus aboard the plane transmits 70 readings each ½ sec. to the receiver on the ground. There the readings are recorded on sound film and a wax record for later transfer, in another unit of the recorder, to paper graphs for study by the several engineers interested in the data.

Receiving from the regulation radio transmitter aboard the plane, the recorder's pickup range is several hundred miles, permitting the test plane to be flown straight-away for long distances, from low to high altitudes, over level or mountainous terrain, and in all required attitudes. Throughout such flight the test pilot can be kept fully informed, via radio, of exactly what his tests are proving, what stresses and strains are developing, vibration that seem to be building up, and such other information as would enable him to extend or curtail maneuvers and in all ways know what is happening.

Ground receiving and recording units are portable and can be quickly set up in whatever locality is best suited to a particular test. They have been successfully operated below sea level, in Death Valley National Park, and in mountainous as well as ordinary terrain.

The new recorder eliminates currently used photographic methods of recording flight test data and provides a means of warning test pilots of developing trouble. It also eliminates loss of valuable test data in case of a crash. Interception of data so broadcast will prove valueless because the recorder's signals cannot be decoded except by the unit which transfers the sound film and wax record recordings to the paper graphs.



On the ground, portable receiver unit records the 70 signals transmitted each ½ sec. by the unit in the plane, and transmits them to sound film and a wax record simultaneously. Engineer H. D. Giffen, in charge of the development, is shown ready to talk to pilot, via radio, with microphone he holds in his hand. Technicians watch functioning of photograph type recorder and sound film unit.



Signals from units aboard plane are transferred from sound film and wax record to graph paper in this decoding unit. Graphs are then cut in sections and sent to the several interested engineers for study.

Detachable Gasoline Tank Of Molded Plywood

An auxiliary gasoline tank, detachable in flight by pulling a trigger, is the latest development announced by Vidal Research Corporation. Of the conventional teardrop shape, the light weight tank is made entirely of plastic bonded, molded plywood.

Designed to increase the range of ferry craft and for tactical planes in combat mission, these tanks will aid materially in the job of hitting the enemy at long range, and eventually in his own backyard.

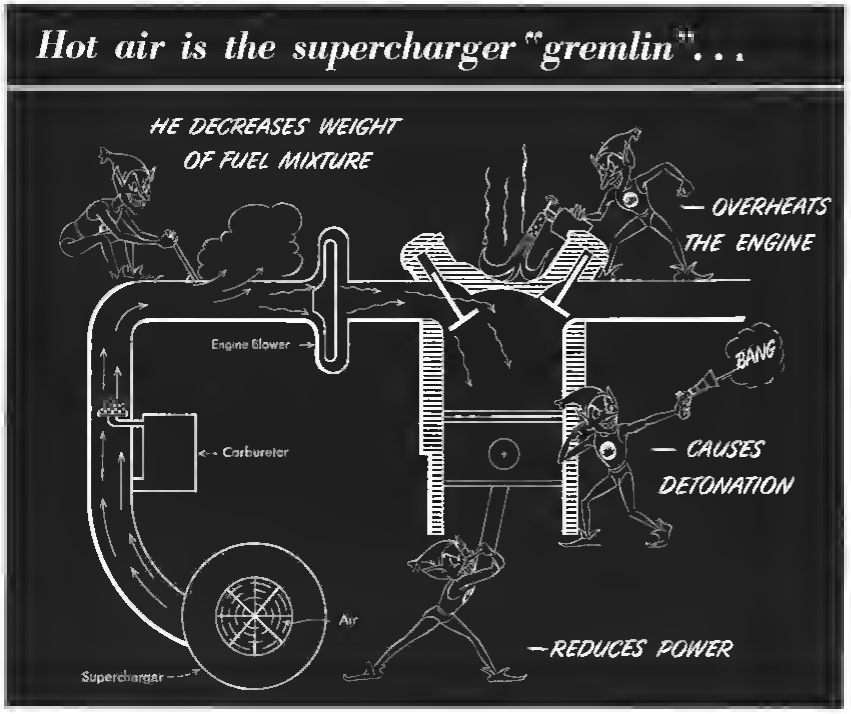
Engineering of the Vidal tank presented many interesting problems. The patterning of veneers to make it leakproof, the fabrication of wooden molds around which the thin strips of veneer were laminated, and the necessity for perfectly balanced baffles to check sloshing, all had to be worked out with the thinnest possible shell commensurate with the load. The tanks are designed to fit under the wings or fuselage. In an emergency they can be dropped quickly, yet the pilot may switch to his regular fuel supply without interruption of gasoline flow to the engine.

Vidal licensees are planning to make tanks ranging in size from 50 to 160 gal. in large volume.

The idea of making gasoline tanks of wood serves to emphasize the productive possibilities of the molding process.



Light-weight detachable gasoline tank made of molded plywood developed by the Vidal Research Corporation to increase the range of tactical aircraft.



AiResearch Intercoolers *provide control that helps raise critical altitudes*

THE SUPERCHARGER in compressing air *heats* it considerably. And as increasing altitudes require more and more air compression—this heat makes it tougher for the power plant to maintain its normal rated power. Thus hot air becomes a "gremlin" that reduces the critical altitude of the power plant.

How well AiResearch Intercoolers have curbed this heat "gremlin" is now proven. Today, on every Allied front, these Intercoolers are helping increase the density of carburetor air intake—helping the power plants of American-made warplanes to deliver *added useable power at critical altitudes.*

Ruggedness is an outstanding feature of the AiResearch Intercooler, despite its extremely light weight. It is manufactured of heat-treated aluminum alloys. Tubes are mechanically fastened and jig assembled—they stand up against back-fire.

And, the entire assembly is anodized for protection against corrosion ... another reason why the AiResearch Intercooler provides freedom from maintenance trouble.

AiResearch Intercoolers are manufactured in flattened or round tubular units ... adaptable to every shape and size requirement. And the intercooling experience of the engineers who developed them is available to all aircraft manufacturers. Inquiries are invited.

AiResearch
MANUFACTURING COMPANY
LOS ANGELES, CALIFORNIA
DIVISION OF THE GARRETT CORPORATION

"Where Controlled Air Does The Job" • Engine Oil Cooling Systems • Engine Coolant Systems
Automatic Exit Flap Control Systems • Supercharger Aftercooling Systems



Bent, twisted, and bullet-damaged propeller blades from the fighting and training fronts of our air forces stacked at Hamilton Standard's "hospital" for repair and return to service

Eighty Percent Salvage On Damaged Propellers

Wartime casualties, propeller blades bent and twisted in crack-ups of training and combat planes and even bearing bullet holes as battle scars, are salvaged at a "base hospital" of Hamilton Standard Propellers Division of United Aircraft Corporation.

The thousands of damaged blades which flow into the plant from depots of the Army and Navy present a weird picture of twisted and battered metal, mute testimony to the rigors of the far-flung battle lines of the United Nations and the great pilot training program of the United States.

With critical metals as scarce as they are this salvaging of repairable blades becomes of increasing importance. Every blade thus salvaged and put back into a plane means one more blow at the nation's enemies.

The solid forged duralumin propeller blades can be reworked in most cases while cold. Because of this many of the less seriously damaged blades are straightened in the field.

Of those which are sent to the factory, approximately 80 percent are repairable—60 percent of these being straightened cold while the remainder must be heated and re-hardened.

After the blades are straightened they are matched in sets of two or three, depending on whether they are from a two or a three blade propeller. The most badly damaged blade of each set is then worked over, the rough edges trimmed off, and shaped up. This blade is used as a "master" for the set and the others formed to match.

The blade is then checked for dimensional tolerances and etched the same as all new Hamilton Standard blades are handled to bring out any possible hidden flaws. After being roughed out by a buffer, the blade is given a final dimensional inspection, and then buffed for its final finish.

So well do these blades stand up after straightening that numerous blades have been returned after a second crackup, repaired again and sent out for use.

Wiring Board Speeds Harness Assembly

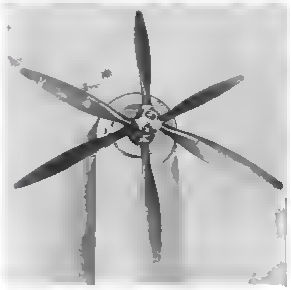
Vega has reduced the average time necessary for wiring the B-17, which is entirely an electrical airplane, to about two-thirds that of a smaller airplane which uses electrical equipment only to a limited extent.

A wiring board generally comprises a wooden table on which the path of the wires which constitute the wire circuits is traced. Posts are located alongside the trace to keep the wire in place as it is laid on the board. The boards are placed almost vertical to save floor space. Wires are laid one at a time and are then laced together. The complete assembly constitutes a harness which is ready for installation in the airplane. The boards have been designed to permit the simultaneous assembly of several harnesses which permits a better labor load distribution and a maximum utilization of the assembly board and space. The wires are used continuously coded by means of a printing roller through which the electric wire is run prior to assembly.

This system saves aluminum conduit tubing, its procurement, storing, handling, cutting and bending and saves pulling wires through conduits in the crowded space of the fuselage.

New Hydraulic Dual Rotation Propeller

A new dual rotation propeller, the first to be built as a self contained unit with its own hydraulic system has recently been completely developed by Aeroproducts Division of General Motors Corporation. This contra-rotating propeller is equipped with Aeroproducts' hollow, ribbed steel blades. The propeller is of automatic, constant-speed, controllable-pitch design and the only external mechanism outside of the propeller unit itself is the control lever in the cockpit. With greatly increased power available in new engines, the size of the ordinary three- or four blade propellers would become prohibitive. Therefore, the six-bladed dual rotation Aeroprop, consisting of two self-contained, three bladed units rotating in opposite directions, was designed and built.





Wiring boards in nearly vertical position enable operators to assemble several B-17 harnesses simultaneously. The boards are carefully marked and arranged so that inexperienced workers can complete the assembly without difficulty



GIVING ENEMY PILOTS *ONE-WAY* TICKETS

VICKERS HYDROMOTIVE CONTROLS

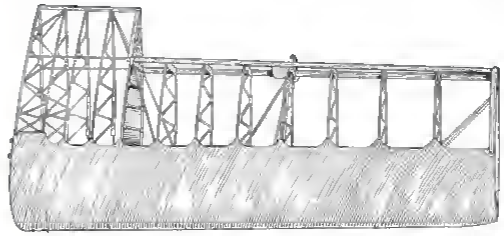
Every improvement which makes our war planes superior in performance to those of the enemy helps two ways—

It helps give enemy pilots one-way tickets to the fight—helps give our pilots round trip tickets. It means that more of our pilots and crews return successfully—that more of the enemy's do not get back.

Vickers Hydromotive Controls are helping give American war planes definite superiority. These high pressure oil hydraulic controls are instantly and easily responsive—but insensitive to shock and vibration . . . they are dependable, accurate, and easily adjusted. They have been found ideal in a wide variety of control jobs.

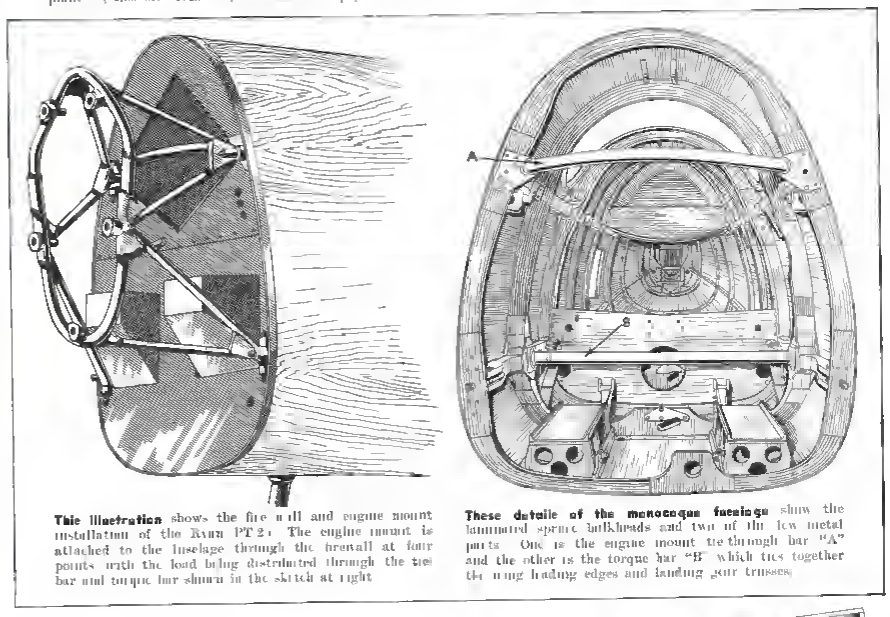
VICKERS
Incorporated
1462 OAKMAN BLVD. DETROIT, MICHIGAN

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921



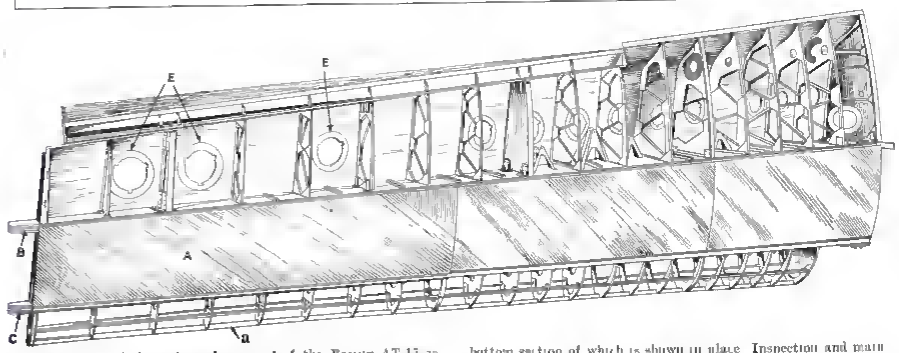
The monocoque wing construction of the Ryan PT-22 employs a formed leading edge the only formed section on the plane. The stalt has been so designed that standard flat sheets are used elsewhere. The entire wing is fabric covered over the primary structure. A similar type of construction using metal instead of plywood was employed on the Ryan S-C metal cabin plane. (Also see AVIATION, October 1942 page 234.)

SKETCH BOOK OF DESIGN DETAIL



This illustration shows the fire wall and engine mount installation of the Ryan PT-22. The engine mount is attached to the fuselage through the firewall at four points with the load being distributed through the tie bar and torque bar shown in the sketch at right.

These details of the monocoque fuselage show the laminated spruce bulkheads and two of the few metal parts. One is the engine mount tie through bar "A" and the other is the torque bar "B" which ties together the wing leading edges and landing gear trusses.



Construction of the outer wing panel of the Boeing AT-15 is shown above. The plywood skin between the spars "B" and "C" is heavier than that which will form the leading edge at "D." A still lighter plywood covering is used on the trailing edge, the bottom section of which is shown in place. Inspection and maintenance are facilitated by extensive use of inspection holes, some of which are shown at "E." (Also see AVIATION, December, page 263.)



Lots of Uncle Sam's Chillun Got Wings

Fighting pilots are made—not born.

And to make enough pilots to fight a global war . . . enough navigators . . . enough bombardiers . . . requires training planes, training planes and *more* training planes.

Since Hitler gave the order to march on Poland, more primary training planes have come from Boeing's Midwestern plant than from any other single American plant.

That's why Boeing men and women get an extra-special thrill when they read of American bombers and fighters hitting the enemy where it hurts. They know the odds are that the men in those planes got their "primary" in a Boeing trainer.

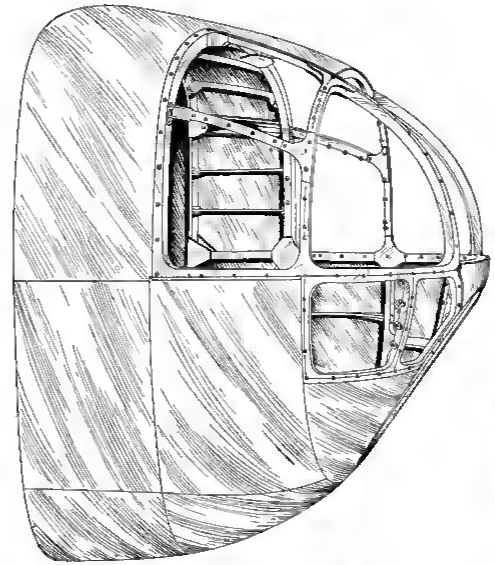
Boeing training planes include the Army's PT 17, the Navy's N2S-2 and N2S-3, and the new bomber-crew-trainer AT-15 in which pilots, bombardiers, navigators, gunners and other crew members are given integrated training. And at training fields in Great Britain and China . . . in Canada, Mexico and Cuba . . . in six South American republics . . . Boeing planes are helping young men to sprout their wings of war.

. . .

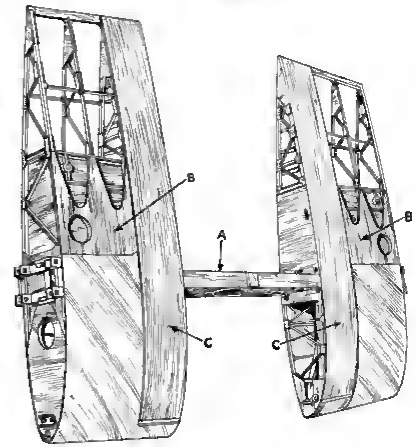
The engineering and manufacturing skill expressed in Boeing primary trainers, crewtrainers, Flying Fortresses, Stratoliners* and Pan American Clippers will some day be directed to peacetime pursuits. Then Boeing wartime research . . . in radio and refrigeration, heating and hydraulics, soundproofing and a score of other engineering fields . . . will make the fruits of victory ripen sooner and sweeter.*

DESIGNERS OF THE FLYING FORTRESS • THE STRATOLINER • PAN AMERICAN CLIPPERS **BOEING**

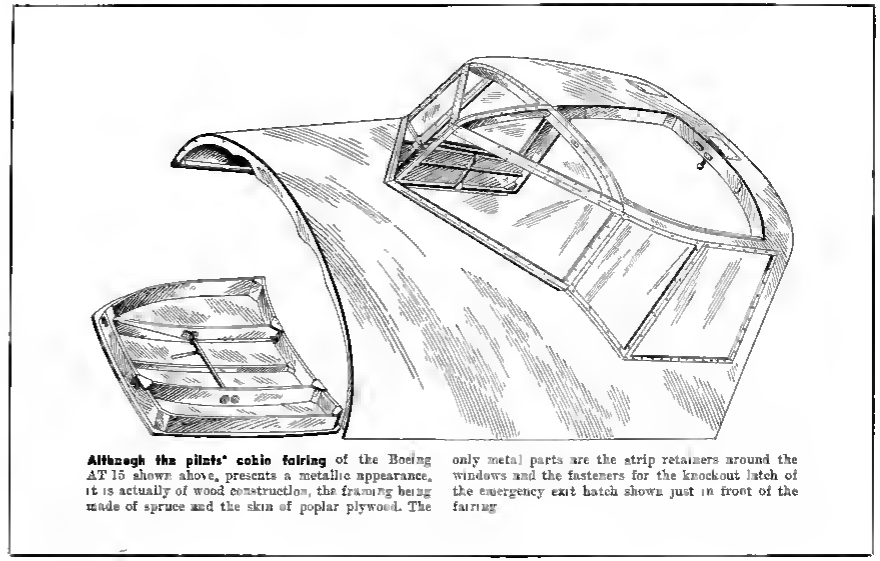
*THE TERMS FLYING FORTRESS AND STRATOLINER ARE REGISTERED BOEING TRADE MARKS



This side view of the nose section of the Boeing AT-15 shows the extensive use of wood in the construction of this bomber crew trainer. Since both the student bombardier and his instructor often occupy the compartment at the same time, heavier material is used in the construction. The only metal parts are window strips and fittings.



The center-wing section of the Ryan PT-20 is shown above at right. It is comprised of a monospar "A," and nose ribs and trailing edge ribs. Plywood gas cells "B" are located immediately behind the spar. Plywood walkways "C" are placed on both inboard sides of the section.



Although the pilots' cabin fairing of the Boeing AT-15 shown above, presents a metallic appearance, it is actually of wood construction, the framing being made of spruce and the skin of poplar plywood. The only metal parts are the strip retainers around the windows and the fasteners for the knockout latch of the emergency exit hatch shown just in front of the fairing.

The behavior of PLEXIGLAS UNDER PRESSURE



To study the behavior of curved PLEXIGLAS panels under pressure, the Rohm & Haas physics laboratory constructed the apparatus shown here. A 30" square sheet of ½" thick iron was formed to a cylindrical section with an outside radius of 32 inches. The PLEXIGLAS panels are placed between rubber gaskets and clamped to the iron plate with curved and straight iron straps 1" wide. Clamping pressure is obtained by bolting down short lever sections of channel iron. The size of free area of PLEXIGLAS subjected to pressure can be varied by using different sizes of strips. Air pressure is applied through holes in the metal plate. The deflection of the center of the panel is measured by a dial gauge.

THE design of high altitude planes and the resultant need for pressurizing cabins raises the question of the deflection of the center of PLEXIGLAS panels installed in these cabins when subject to pressure. A report containing the data assembled to date on this subject by Rohm & Haas engineers is now available.

This report, entitled *PLEXIGLAS: Deflection-Under-Pressure* recommends spherical or cylindrical shapes for all PLEXIGLAS panels to be used in pressurized cabins. It describes the effect of temperature, of clamping pressure and gasket thickness on such acrylic sections, and suggests the correct width and depth of the channels in which they are inserted. Twenty-three significant graphs supplement the text.

Write for your copy of this valuable report today, Rohm & Haas Company, Washington Square, Philadelphia, Pa.; 8390 Atlantic Blvd., South Gate, Los Angeles, Calif.; 619 Fisher Bldg., Detroit, Mich.; 930 No. Halsted St., Chicago, Ill. *Canadian Distributor*—Hobbs Glass Ltd., Montreal, Canada.

THE CRYSTAL-CLEAR ACRYLIC PLASTICS

PLEXIGLAS

SHEETS AND RODS

★

CRYSTALITE

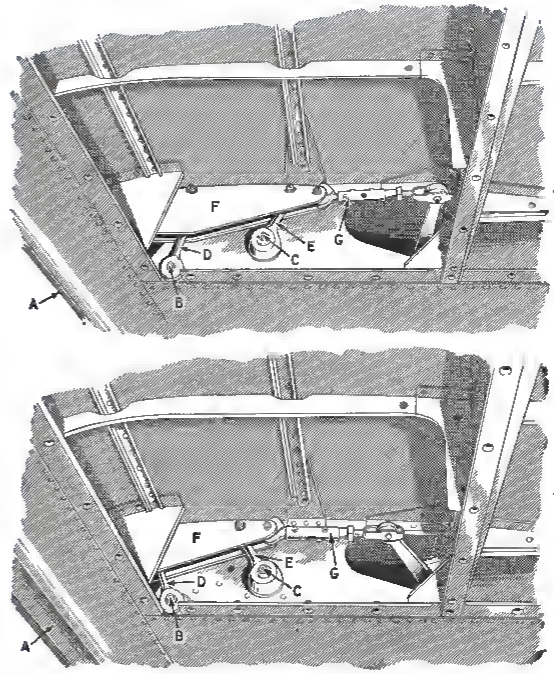
MOLDING POWDER

PLEXIGLAS *and* CRYSTALITE *are trade-marks, Reg. U. S. Pat. Off., for the acrylic resin thermoplastics manufactured by the Rohm & Haas Company.*

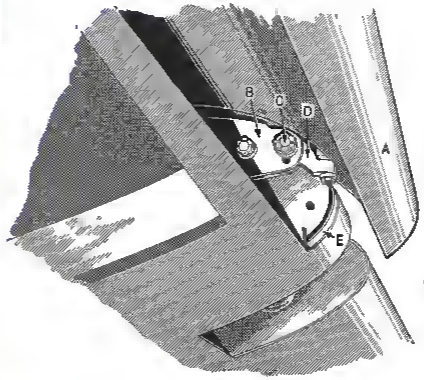
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WASHINGTON SQUARE, PHILADELPHIA, PA.

Manufacturers of Leather and Textile Specialties and Finishes... Enzymes... Crystal-Clear Acrylic Plastics... Synthetic Insecticides... Fungicides... and other Industrial Chemicals

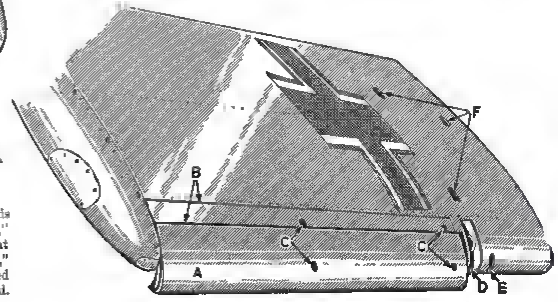


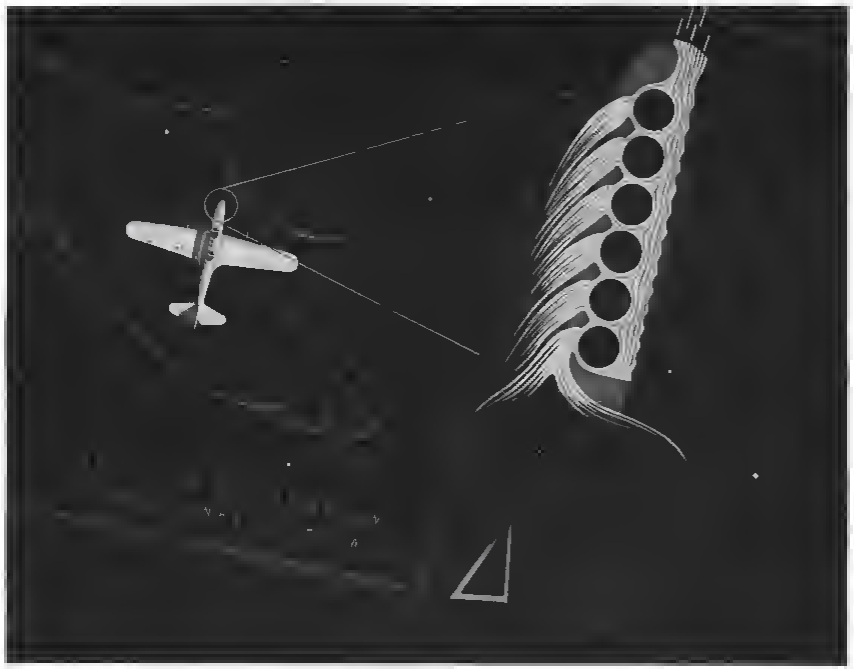
The wing slot "A" of the Messerschmitt Me 109 is of the automatic type, operating on a linkage mechanism. "B" and "C" are the hinge points for the linkages "D" and "E" which are free to swing back and forth. The member "F" is attached directly to the slot on the rear of which at "G" is attached a separate linkage mechanism that is connected to the other end of the slot to permit only smooth operation to prevent jamming caused by one end moving out ahead of the other. In the above position the slot is open; the lower sketch shows it closed.



The Messerschmitt Me 109 slot "A" shown above is attached to the wing by means of the fitting "B," which is movable. The bolt "C" permits adjustment of the slot, since it carries the forked fitting "D," which is joined directly to the slot. Note the indented lip at "E" to make a tight fit when the slot is closed.

The wing slot of the Messerschmitt Me 109 is shown open in the sketch below. The slot "A" is built so that the lip at "B" fits smoothly into the wing, leaving no rough edges to collect ice or hinder lift. The bolts "C" are for access to adjust the attachment fitting of the slot. One of the wing guns is fitted at "D" while the hole "E" is for a gun camera. Points "F" are for inspection plates.





Ranger Solves the In-Line Air Cooling Problem

A scientifically engineered air scoop, baffle, and air pressure reservoir" arrangement delivers uniform air pressure at each cylinder, maintaining uniform temperature in all cylinders at all times.

When Fairchild began its researches into the air-cooled, in-line aircraft power plant, it began "from scratch." The formidable difficulty of air-cooling cylinders which were set one behind another had discouraged many. Interest had been diverted to radial air-cooled and liquid in line design. Fairchild believed that the tremendous advantages of air-cooling combined with those of inverted, in line arrangement were vital to this country's aeronautical progress. Fairchild spent a decade in the laboratory developing such an engine type . . . the Ranger. A simple yet amazingly efficient method of "pressure cooling" solved the primary problem. Today—the only engines of their kind in America—Ranger air-cooled, inverted, in-line engines are powering the planes of the United Nations. They are the most efficient and reliable engines in their power class. They not only justify in every respect the years spent in their development but, as with all Fairchild achievements in the science of aeronautics, they bear the unmistakable Fairchild "touch of tomorrow." Continuing researches demonstrate that they are the beginning of a new and brilliant chapter in aircraft engines and the planes which they make possible.

ON THE BEAM

"This government, the offspring of your own choice, has a just claim to your confidence and your support." George Washington

RANGER AIRCRAFT ENGINES

Division of Fairchild Engine and Airplane Corporation · Farmingdale, Long Island

Plywood Adhesives

Characteristics and Handling Methods

Adhesive	Blood albumen	Casein	Animal	Vegetable starch	Soya bean and vegetable protein	Urea-formaldehyde resins	Phenol-formaldehyde resins	Thermoplastic resins	Blood and urea-formaldehyde combined	Blood and phenol-formaldehyde combined
Source	Dried beef blood	Precipitated from milk	Hides and bones of animals cooked in water evaporated, grilled dried	Vegetable carbohydrate Base mainly cassava (tapioca); also potato flour	Mainly soya bean meal also peanut and cottonseed meal	Urea-CH_2O condensation	Phenol-CH_2O condensation	Chiefly plasticized polyvinyl butyraldehyde	Urea resin plus dried blood	Phenol resin plus dried blood
Form Supplied	Powder Tolr	Powder	Powder pearl flake shreds	Flour	Flour	Powder and liquid	Lumps powder liquid and film	Resin solution in organic solvent	Resin and blood separately	Resin and blood supplied separately or mixed
Cold or Hot Press	Hot press	Mainly cold some hot	Cold and cold with warm cauls	Cold	Mainly cold some hot	Mainly hot some cold	Mainly hot, some cold	Hot press	Hot press	Hot press
Added Ingredients at Mix	Water alkalis, paraformaldehyde corn syrup invert sugar, hydrated lime oil-immersion adhesives, etc	Water CH_2O preservatives and alkalis (lime and sodium salt)	Water some preservatives	Water and alkalis (sodium hydroxide)	Water lime silicate of soda, carbon bisulfide	Water accelerators, wheat and rye flours	Alcohol and water flour fillers	None, thin with solvent if necessary	Water, accelerators, wheat and rye flours	Water and reagents
Preparation for Use	Mixed cold	Mixed cold	Soaked in cold or warm water followed by cooking	Generally mixed hot	Mixed cold with water	Some mixed with water only others accelerator and flour added	Dry film as is. Liquid resin as is. Solid resin dissolved in alcohol and water. Catalyst added for cold pressing. Warm settings and fast hot pressing	None	Mix ingredients cold	Mix cold or use as supplied
Life of Mixture	2 hr to several days	2 hr to 2 days (preferably short)	Extended if preserved	Many days	Several hours for cold process	Several hours to 1 day	Extended for hot press material Several hours for cold press resin	Indefinite Not reactive	Several hours	Short — to long
Spreading and Handling Equipment	Roller spreader	Roller spreader	Heated roller spreader	Roller spreader	Roller spreader	Roller spreader	Liquids in roller spreader Film used as is	Roller spreader	Roller spreader	Roller spreader
Spread Pounds per Thousand Square Feet — Dry Basis	10–35	12–35 Medium mixture	25–35	20–30	25–35	16–25	30–40 for cold press resin 10–14 for hot press liquid 11–12 for film	6–14	16–25	16–25
Assembly Time in Minutes	20–40	1–20	1–15	1–40	1–20	1 minute to 5 days	Hot press liquid 1 min. to several wks. film any length Cold press, 5–30 min	Several hours plus—must be dried	1–20	1–10
Pressing Temp.	180–250° F	Ordinary room temp for cold press 180–250° F hot press	Cold with warm cauls	Ordinary room temp	Cold at room temp Hot press at 180–200° F	210–240° F	Room temperature to 320° F	230–300° F	230–260° F	220–300° F

(Continued on page 175)



Young *AERONAUTICAL HEAT TRANSFER EQUIPMENT*

OIL TEMPERATURE REGULATORS — OIL COOLERS — SUPERCHARGER INTERCOOLERS
LIQUID COOLED ENGINE RADIATORS — CABIN HEATERS

Since the infancy of the aviation industry 29 years ago building better heat transfer equipment has been an art with the men of Young Radiator Company. Knowledge born of experience with military and commercial aircraft, plus practical factory and power plant training is incorporated into the design, testing and manufacturing of YOUNG Aeronautical products. YOUNG Oil Coolers, Oil Temperature Regulators, Radiators for liquid cooled engines, Supercharger Intercoolers, and heating and cooling units are results of this specialized experience.

Specification changes to meet new demands of military combat can be met by placing them with our engineers. We will build to the specifications you have to meet. We welcome your special problems, as well as straight line production of the common types of oil temperature regulators and radiators for liquid cooled engines.

YOUNG RADIATOR COMPANY, DEPT. 293-A RACINE, WIS., U. S. A.

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CABIN HEATING COILS
Made in several types. Lightweight construction, amply heat transfer surface. Used in Army and Navy planes.



YOUNG UNIT HEATERS
Widely used for heating bungalow, colonial, Italian buildings and factories. Made with horizontal and vertical airflow in a wide range of capacities.

Young SERVICE — SPECIALIZING IN HEAT TRANSFER PRODUCTS

OIL COOLERS • GAS, GASOLINE, DIESEL ENGINE COOLING RADIATORS • INTERCOOLERS • HEAT EXCHANGERS • ENGINE JACKET WATER COOLERS

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HEAT TRANSFER PRODUCTS

Plywood Adhesives

Characteristics and Handling Methods

Adhesive	Blood albumen	Casein	Animal	Vegetable starch	Soya bean and vegetable protein	Urea formaldehyde resins	Phenol-formaldehyde resins	Thermoplastic resins	Blood and urea formaldehyde combined	Blood and phenol-formaldehyde combined
Pressing Time	3 min. for hot press; varies with thickness of panel. Overnight cold press	2–28 hr. for cold press; 3 min. for thin panels hot press	2–18 hr.	4–18 hr.	2–6 hr. for cold press; 3–8 min. for hot press	3 min. for thin panels hot press; 8 hr. for cold press	3–6 min. for thin panels hot press; overnight for cold press	Few minutes (use several hours—must be cooled in press under load)	7–8 min.	8–11 min.
Moisture Content Allowed in Veneers	2–8% for faces; 5% or less for cores and crossbands	Same as at left	Same as at left	Same as at left	Same as at left	Wide range—2–100% under special conditions	2–14% for liquid resin. For film types and crossbands 5–10%. Faces 2–6%	3–12%	4–14%	2–4%
Conditioning of Panels After Pressing	Unnecessary for hot press; necessary for cold press. Dry to 7% M.C. for indoors, 12% M.C. for outdoors	Same as at left	Same as at left	Same as at left	Same as at left	None	Generally none; sometimes dipped or sprayed with waterproof glue	Generally none; sometimes sprayed	None usually	Dipped for 4 hrs.
Dry Bond Strength	Medium	Medium	Very high	Medium	Medium	High	Medium to high	Low to medium	High	High
Wet Bond Strength	Medium	Poor to medium	None	None	Poor to medium	Medium to high	Excellent in both hot and cold water	Medium	Medium	Medium
Water Resistance	Medium	Poor to good	Poor	Poor	Fair	Cold water: Good. Hot water: Fair	Excellent	Medium	Good	Good
Mold Resistance	Poor to good	Generally poor	Poor	Poor	Poor	High	Excellent	High—not affected	Fair to poor	Fair to poor
Staining Power	Low to high	Generally marked	Some staining	Generally marked	Marked	None	Some staining with liquids; none with film	None	No stain. May diffuse	No stain. May diffuse
Heat and Fire Resistance	Poor	Poor	Poor	Poor	Poor	Moderate	High	Poor	Moderate	Moderate
Moisture Transmission	Marked	Marked	Marked	Marked	Marked	Medium	Low	Low	Medium	Medium
Exterior Durability	Fair to good	Good	None	None	Poor	Good	Excellent	Poor to good; tendency to pull in cold conditions	Good	Good
Relative Cost	Medium to high	Medium to high	High	Very low	Very low	Resin: ultra high. With fillers: low	High	High	Medium	Medium
Principal Uses	Refrigerator truck and car panels; special panels; packaging	Furniture and interior panels; concrete forms	Principally for lumber cores and joints	Furniture panels, gauges, production work packages	Douglas fir panels, flying boats; concrete forms	Wall panels; radio cabinets; furniture; flush and curved	Two-ply laminating; interior panels; aircraft skins, boats	Molded plywood	Panel stock; furniture	Douglas fir
Special Features	Especially suitable for low temp. hot pressing; most durable of all; heaviest except resin. Also mixed with casein and soya bean flours	Superior to vegetable glue for wet strength	Relatively expensive. Easy to use	Inexpensive, popular adhesive. Most western plywood made with cassava flour	Mostly soya bean meal used on Douglas fir	Very economical when mixed with flour. Provides a highly water resistant limit set hot or cold	By far the most durable bond; resists all forms of deterioration	Flows at elevated temperature. Must be cooled in press. Will reseal. Plastic return flexibility	Rather critical to handle. Partially resistant to boiling water	Popular for Douglas fir because good durability is attained with fast low temperature cycle

Courtesy of Bakelite Corporation

Review of Patents

By A. HARRY CROWELL,
Registered Patent Lawyer

FOLLOWING are digests of the more significant of recent patents on aviation developments announced by the U. S. Patent Office. Mr. Crowell will be glad to furnish AVIATION readers with preliminary information entirely without charge respecting their patent and trademark matters. Address inquiries to Mr. Crowell, care AVIATION, 330 W. 42nd St., New York. Complete printed copies of any patents listed below are obtainable, at a cost of 10¢ each, directly from the U. S. Patent Office at Washington.

Radio Shielded Ignition Means, 2,296,714, W. J. Spengler, assignor to Bendix Aviation Corporation. A combination of radio shielding harness with the current generating and distributing means, particularly in aircraft. The shielding harness has one or more ignition distributor blocks mounted therein.

Aircraft Pilot Training Device, 2,300,004, H. Nicholson, assignor to Aircraft Industries Co. A machine for training a student pilot to properly coordinate the manipulation of the stick and pedals of an airplane so as to properly bank the airplane while making a turn.

Propeller Blade Mounting, 2,300,233, E. Martin, assignor to United Aircraft Corporation. A mounting for a hollow steel blade, including an anti-friction bearing in which the blade itself provides one of the bearing races.

Sealed Engine Container, 2,300,250, A. E. Kueppers, assignor to Wright Aeronautical Corporation. A closely fitted hermetically sealed metallic case encarrying less bulk and eliminating the need of anti-rust preparations for the engine.

Shafting, 2,300,293, J. W. Kinnucan, assignor to Continental Aviation & Engineering Corporation. A shaft connection constructed and arranged to be readily assembled together to facilitate the assembly and driving connection of an aircraft propeller shaft with an engine. It may also be used in other places in an aircraft powerplant.

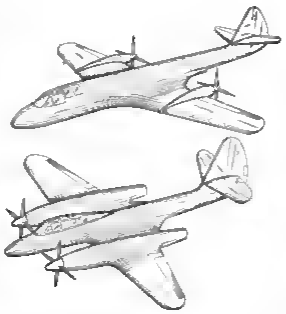
Variable Pitch Propeller Control, 2,300,418, J. H. Hammond, Jr., and G. A. Colley, Colley assignor to Hammond, Jr. Invention provides torque responsive means, operated by propeller shaft, which directly controls means for varying pitch of propeller blades in such way as to maintain propeller-shaft torque constant. Rate of change of pitch of propeller blades is also varied in accordance with rate of changes of propeller shaft torque.

Erecting Means for Gyroscopes, 2,300,548, H. G. Hamilton, assignor to Bendix Aviation Corp. Invention deals with gyroscope devices of type adapted for indicating true vertical so as to provide an artificial horizon on aircraft. A novel self erecting mechanism is provided.

Universal Flight Instrument, 2,300,685, Walter McKay, assignor to Sperry Products, Inc. Invention relates to improvements in universal flight indicators, and in such instruments there is provided a sensitive element which is substantially unresponsive to small and short period disturbing forces acting around the horizontal axes, that is, the X and Y axes. There is obtained a slow period action around the vertical axis, while the long period around the X and Y axes makes the instrument particularly useful as an artificial horizon or altitude-of-flight indicator.

Gyromagnetic Compass, 2,301,200, B. G. Carlson and B. A. Wittkuhns, assignors to Sperry Gyroscope Co. Invention relates to improved magnetic control, for directional gyroscopes, in which influence upon magnetic element of steel bearings and pivots is balanced, or in which magnetic element is located in such a way as never to change its relative position with respect to other magnetic parts in instrument. In order to effect compensation for latter. Other improvements are also embodied.

Cylinder Barrel Construction, 2,301,235, A. V. D. Willgoos, assignor to United Aircraft Corp. Improved engine cylinder having separate cylinder barrel, head, and barrel fin portions. Improved head attaching means is arranged to facilitate assembly of barrel fin portion on barrel and obviate necessity of thickened barrel portion within finned area.



Two new pursuit plane designs developed by James S. McDonnell Jr., and assigned to McDonnell Aircraft Corp. (Top, D 134, 425; above, D 134 426.)

Vibrationless Aircraft Seat, 2,301,603, F. E. Flader, assignor to Curtiss-Wright Corp. Seat is insulated by resilient devices, to prevent vibration transmission thereto, and is adjustable as to height and angle. Adjustment means is particularly appropriate to aircraft pilot seats.

Rotative Winged Aircraft, 2,301,417, A. E. Larsen, assignor to Autogiro Company of America. Calls for driving airscrew mounted on a blade of lifting rotor, preferably adjacent to tip thereof, and there is employed jet propulsion means for actuating driving airscrew. Is especially for use in craft of type in which rotor drive means are provided setting up no appreciable driving reaction in the body, thereby enabling helicopter flight with a single rotor, without necessitating provision of any means for counteracting torque.

Internal Combustion Engines, 2,301,434, C. F. McNeil, assignor to Bendix Aviation Corp. Invention relates to method and mechanism for controlling propellors of multi-engine aircraft to maintain them in sychronous rotation, control being operative upon the said propellers to change blade pitch and thus restore synchronism following a temporary deviation therefrom.

Airplane Fuel Tank Safety Device, 2,301,483, G. Van Daam. Invention includes provision of means on external surface of an airplane which will release an extinguishing fluid in a fuel tank upon wreckage of airplane, also means for cutting off fuel to carburetor to reduce fire hazard.

Resilient Engine Mount, 2,302,074, J. M. Tyler, assignor to United Aircraft Corp. Resilient engine mount, constructed entirely of metal, has controlled flexibility in various directions. Installation and removal of engine is facilitated. Embodied are number of tubular elements, some of different diameters than others.

Navigation of Aircraft, Ships, or the Like, 2,302,210, A. Graves, assignor of one half to Alitnola Limited. Apparatus for indicating to a navigator the compass bearings appropriate to great circle navigation between two points. Comprises setting device adjustable to represent latitude of vertex of required great circle, a setting device capable of initial adjustment to represent distance of starting point from vertex measured along said great circle and of subsequent adjustment to represent variations in said distance at successive points on great circle, and means responsive to adjustment of said setting devices for indicating at each stage of journey the compass bearing necessary for continued travel along great circle.

Supercharger Control, 2,301,072, R. M. Nardone, assignor to Bendix Aviation Corp. Novel supercharger drive includes friction clutch of centrifugal type and also a friction brake by which volume of air compressed and fed to engine may be varied at will. Provides novel means for actuating supercharger at variable speed.



MAKE 1 MACHINE DO THE WORK OF 2



Photo courtesy of Republic Aviation Corporation

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For more complete information send for Bulletin ADW-47

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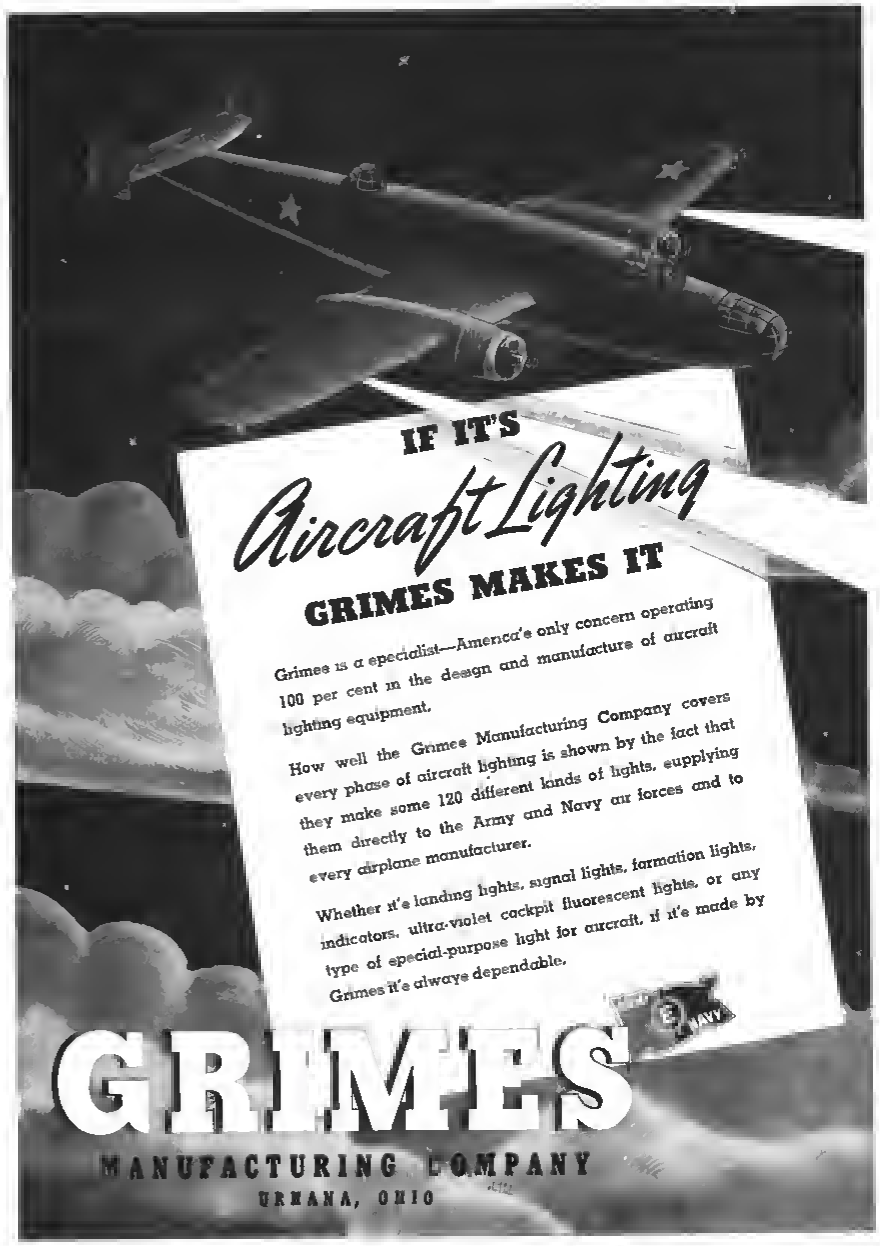
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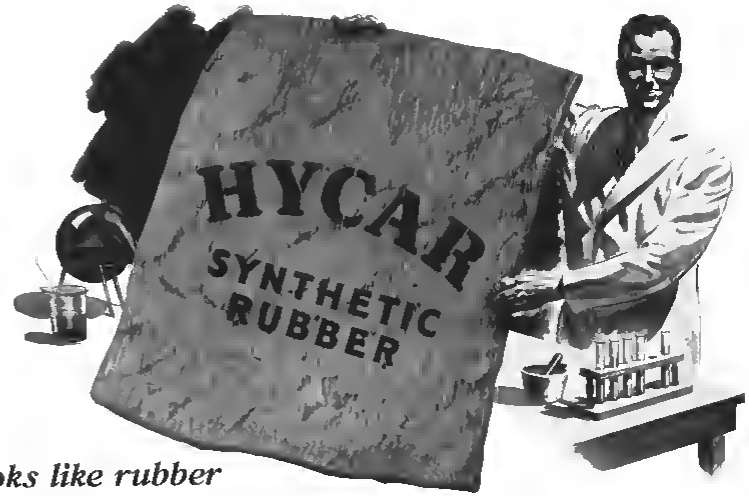
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Squeeze Riveters 1

Just off press is new *Hanna Squeeze Riveters*, 28 page catalog covering many of 760 styles and sizes of rivetrite to line made by Hanna Engineering Works, 1765 Elston Ave, Chicago. Units and methods are profusely illustrated.

Tubing Seal-Fittings 2

Nine page catalog titled *Tubing and Pipe Protection Methods*, issued by Tubing Seal Caps, Inc., 216 W. Seventh St., Los Angeles, includes illustrations and descriptions of uses of tubing seal fittings in aircraft plants.

Precision Tools 3

Aero Tool Co., 231 W. Olive St., Burbank, Calif., offers its 1942-'43 catalog of cut forged computameter inserted, micro glass polished precision aircraft tools.

Flow Rate Instruments 4

Aviation Rotameters is title of new catalog section prepared by Fischer & Porter Co., 110 W. Penn St., Germantown, Philadelphia, Pa. Well illustrated and diagrammed, section describes fuel flow rate, anti-ice fluid, oxygen flow, dynamometer fuel consumption, and pump testing uses of devices.

Worker Fatigue 5

A nine page brochure available from American Bottlers of Carbonated Beverages, 1128 16th St., N. W., Washington, D. C., titled *Fatigue vs. Efficiency* points to close relationship between accident rate and fatigue. Effects on both employee and production curve, and methods of relief, are detailed.

Lubrication 6

Keystone Application Guide, 26 page booklet offered by Keystone Lubricating Co., 21st. Clearfield and Lippincott Sts., Philadelphia, presents recommendations covering lubrication of industrial machinery. Cutting oils and coolants used in aviation industry are covered.

Control of Ice on Runways 7

Titled *Ice Control for Airport Runways*, Brief No. 152 issued by Calcium Chloride Assn., 3144 Penobscot Bldg., Detroit, describes means of skidproofing hard packed snow or ice with abrasives and softening up of snow so that it may be bladed off airfield. Moreover, further information is detailed in Association's Bulletin No. 27.

Se Hydraulic Accumulators 8

Offered by Simmonds Arroressories, Inc., 10 Rockefeller Plaza, New York City, is *Handbook of Instructions* on *Simmons Oliver Hydraulic Accumulator for Aircraft*. Current are installation, inspection, maintenance, and testing. Book also lists causes and corrections for various problems encountered.

Mechanical Goods Catalog 9

New loose-leaf catalog service, particularly for aircraft design engineers, has been instituted by United States Rubber Co., Rockefeller Center, New York City. Initial section comprehensively covers field of mechanical goods. Charts, blueprints, and photographs are included, and pertinent government specifications are listed with each item.

On Chrome-Molybdenum 10

Revised version of *Section II—Chromium Molybdenum Steels* for inclusion in earlier issued book *Molybdenum in Steel*, has been issued by the Climax Molybdenum Co., 500 Fifth Ave., New York City. Newly available data is contained in this 34 page revision.

Terminals and Connectors 11

Thomas & Betts Co., 30 Butler St., Elizabeth, N. J., announces publication of its Catalog No. 36, covering terminals, connectors, and bonding jumpers for electrical wiring in aircraft industry. Additional sheets and pages will be issued as firm's line changes or expands.

Concrete Mix 12

Available from Master Builders Co., Cleveland, is 24 page pamphlet titled *Cement Dispersion and Air Entrainment in Concrete Pavement Construction*. It contains details and partly technical account of character, development, and use of HP 7, firm's product designed for adding to paving mix to gain new transverse strength, resistance to wear, and freedom from scaling.

Nut Interchange Data 13

In accordance with recommendations by WPB, Tinnerman Products, Inc., Cleveland, has compiled complete set of interchange sheets, showing what type of its Speed Nuts are interchangeable with other approved self-locking nuts for uses in non-structural assemblies and attachments of aircraft.

Moisture-Damage Reduction 14

Folder available from Dawson Chemical Corp., Baltimore, describes principles of protection of its product, Protek-Sork, used to reduce loses caused by moisture damage, to which aircraft industry instruments, machinery, and units are vulnerable.

Electric Circuit Controls 15

Guardian Electric, 1617 W. Walnut St., Chicago, has published a four page folder titled *Controls by Guardian for Aircraft Electric Circuits*. Featured are diagrams, pictures and description of company's B-4 solenoid contactor unit, designed to AAF specifications for remote control of starting motors.

Abrasive Cutting 16

From Andrew C. Campbell Div., American Chain & Cable Co., Inc., Bridgeport, Conn., is available *Abrasite Cutting*, book explaining development and application of abrasite cutting principles. Presented are 32 pages of details, photographs, tables, and operation data.

Lighting and Drying Units 17

Included in booklet *Fostoria Production Weapons*, are sections detailing aircraft industry uses of lighting units and infrared drying equipment offered by Fostoria Pressed Steel Corp., Fostoria, Ohio.

Electric Tool Catalog 18

Portable Electric Tools for Aircraft Production and Maintenance is title of well illustrated 28 page catalog obtainable from Black & Decker Mfg. Co., Towson, Md. Given is complete information, photographs, tables, and descriptions of new tools offered by company.

Taps, Cutters, Threaders 19

Designated Catalog No. 22, new 134 page book issued by Detroit Tap & Tool Co., Butler St., Detroit, describes company's line of standard and special taps, thread milling cutters and other forms of threading tools, thread gages, etc. Also contained are numerous reference tables for the shop man and production engineer.

Resistors, Relay Units 20

Bulletins Nos. 21 and 104, prepared by Ward Leonard Electric Co., Mt. Vernon, N. Y., provide construction, mounting, rating, size, and dimensional information concerning company's Vitrohm strip resistor and Midget metal base relay units.

How to Oil Lathes 21

Oiling the Lathe is title of 18 page bulletin available from South Bend Lathe Works, South Bend, Ind. Issued in a series of lathe service publications, this well-illustrated booklet details maximum performance lubrication for any size or make of lathe.

Price Renegotiation 22

Aid in renegotiating prices and government contracts is provided in four page folder issued by Eddy Rucker Nickels Co., Cambridge, Mass. A profit graph and quantity discount calculator are featured.

N-E Steels 23

New data on N-E (National Emergency) steels has been published by Joseph T. Ryerson & Son, Inc., Chicago. With numerous tables and including graphic diagrams, 31 page booklet is punched to fit Ryerson alloy steel reference books. Thoroughly dealt with are selection and heat treating of N-E steels, with special explanation of Jominy end quench hardenability test.

Metal Hose Data 24

American Brass Co., Waterbury, Conn., offers 13 newly published sheets, comprising section "American Metal Hose Products for the Aircraft Industry, Aeronautical Engineering Data" for inclusion in

Aviation Reader's Service
* AVIATION, 330 W. 42nd St., New York, N. Y. JANUARY

INFORMATION TIPS

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NEW PRODUCTS

Monnel as Lusite 26

Lusite Aircraft Manual just published by E. I. du Pont de Nemours & Co., Plastics Department, Arlington, N. J., is 124 page illustrated book on forming, fabricating, and physical properties of Lusite methyl methacrylate resin for transparent sections for aircraft.

Cutting-Tool Power Slide Rule 27

Rotimule is name of practical cardboard slide rule device offered by General Electric Co., Schenectady, N. Y., for calculating cutting tool power requirements for metal-cutting operations.

Electric Resistance Welder 28

Sciaky Bros., 4915 W. 47th St., Chicago, has prepared new P-M-R Catalog exclusively featuring company's new P-M-R radial portable electric resistance welder Unit, used in aircraft industry, is fully described, diagrammed, and photoillustrated.

Wrenching Bolt Standards 29

Hub-Krome Screw Corp., Hartford, Conn., announces distribution to aircraft designers and engineers of its new catalog *AN Standards for Internal Wrenching Bolts*.

Latest Machine Tools

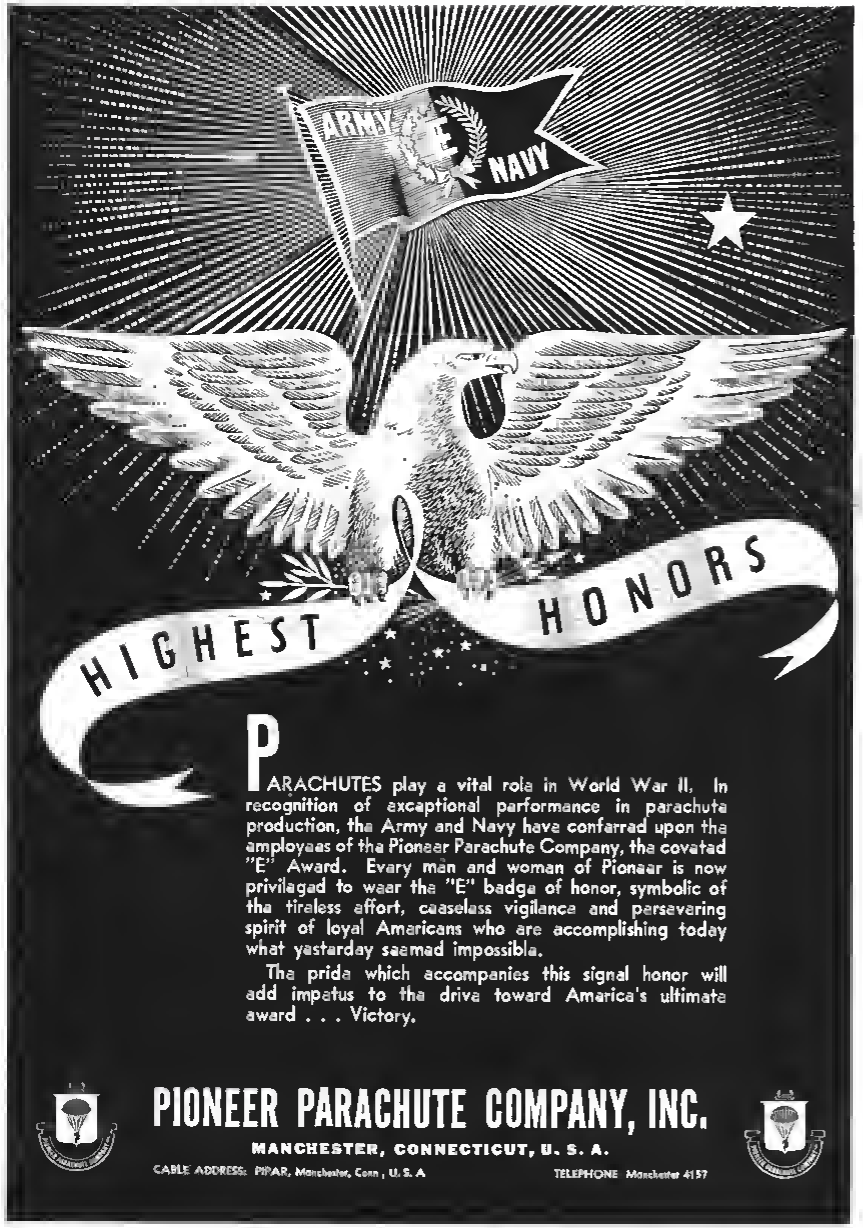
Heat-Treating Furnace 30

New type of forced convection heat treating furnace with heating capacity to 1,750 deg. F., designed to speed up hardening, annealing, normalizing, tempering, nitriding, and other heating operations for production of aircraft parts, is announced by **Lindberg Engineering Co.**, 2444 W. Hubbard St., Chicago. Called the Super Cyclone, new units, states company, increases production by permitting handling of work on fixtures or in work baskets. Heat, developed totally by forced convection, is carried under pressure by high velocity fans through every part of charge. In hardening and drawing of tubular aircraft parts, more than 80 pieces 36 in. long and 1¾ in. in diameter (for example) can be loaded vertically in an alloy fixture for insertion in furnace. Photo shows charge of 3-in rounds (somewhat similar to tubular aircraft parts) coming from work chamber of furnace just prior to quenching operation. Following quench, parts go back into same furnace for drawing. Heating is by gas, oil, or electricity. Circulating fan is in separate chamber away from work chamber. Furnace is made in 30 standard models ranging in work chamber size from 16 in. dia. by 20 in. depth to 72 in. dia. by 84 in. depth.—AVIATION, *January*, 1943



Deep Drawn Press 31

Self-contained H-P-M Fast Traverse deep drawing press for sheet metal, equipped with blankholder and die cushion for drawing large, deep metal airplane parts, is announced by **Hydraulic Press Manufacturing Co.**, Mount Gilead, Ohio. Matched punch and die set is employed, with ring, carried by blankholder slides, holding blank while part is drawn. Usually single-press stroke completely draws part from flat blank. Press is of universal design and can be used to deep draw aluminum alloy, steel, and other sheet metal, with accommodations provided for all standard types of deep drawing dies. Special feature of press is that only one hydraulic pump (pressure generator)



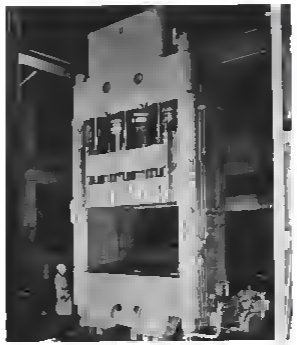
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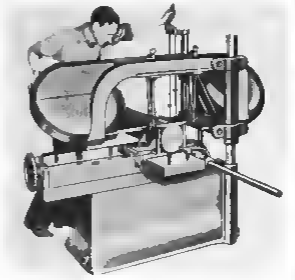
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is required. Speeds are provided to operate the press manually, semi-automatically. Specifications—Pressing member, pressure capacity (tons): Main slide 750, blankholder slide 300, die cushion platen 125, pressing surfaces (L-RxF-B): Main slide, 105x38 in., blankholder slide 102x60 in., die cushion platen 90x40 in.; ram travel (max.) main slide 42 in., blankholder slide 27 in., die cushion platen 10 in.; bed area (L-RxF-B): 120x60 in., motor required (hp. x rpm.) 100x900; shipping weight 231,000 lb.—AVIATION, *January*, 1943.

Metal-Cutting Band Saw.....32

With capacity of 13x16 in. rectangular and 13 in. dia. round, recently introduced Model V-12 metal cutting band saw, made by **Wells Manufacturing Co.**, Three Rivers, Mich., is designed for continuous metal cutting on many larger jobs. Incorporated are features of company's Models 5 and 8, also new hydraulically controlled speed and lift apparatus. Machine is equipped with ¾ hp. electric motor driving blade at a choice of three speeds, 53, 94 or 148 ft. per min. Size of unit is 52½ in. overall height, with 73x30 in. floor space required. Weight of saw is 1,750 lb.—AVIATION, *January*, 1943.



Latha With Auto-Indexing....33

Oster No. 601 Rapiduction turret lathe, now fitted with automatic indexing to replace manual control of turret, is offered by **Oster Manufacturing Co.**, Cleveland. Designed to relieve the more costly machines and highly skilled operators from a wide range of bar and chucking operations, machine has capacity of 1½ in. (round) for cutting-off, boring, tapping, reaming, facing, threading, and for many other operations. Where three or fewer operations in sequence are required, machine can be furnished with plain saddle instead of six-station turret. Lathes can be specified with worm or direct drive to spindle, a two-speed motor, reverse, electric brake control. Motor connects by means of multiple V-belts, with speed changes being obtained by application of quick change sheaves from 140 to 1,000 rpm. on worm-drive design with 1,800/3,600 rpm. motor, and 70 to 500 rpm. with 900/1,800 rpm. motor; and



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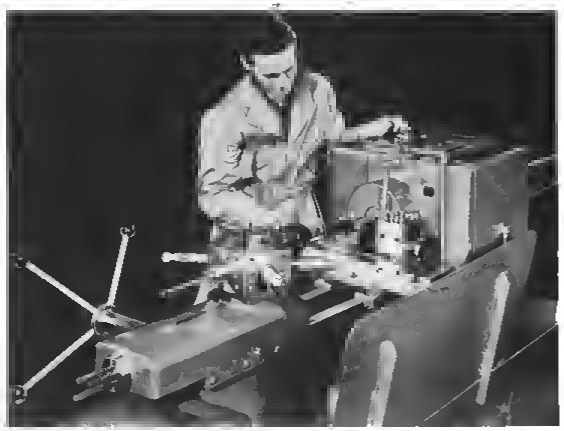
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- ☐ Cold Immersion Cleaning
- ☐ Cold Spray Cleaning
- ☐ Flow Maintenance
- ☐ Glass Cleaning
- ☐ General Plant Maintenance
- ☐ Hot Immersion Cleaning
- ☐ Magnesium Processing
- ☐ Paint Camouflage Cleaning
- ☐ Paint Department Maintenance
- ☐ Paint Stripping
- ☐ Phosphatizing
- ☐ Scale Removal and Control
- ☐ Stainless Steel Processing
- ☐ Steam Baths Maintenance

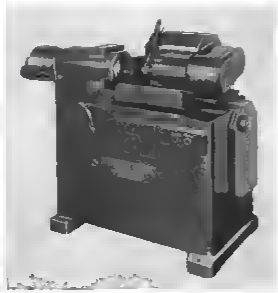
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Factories in Los Angeles and Chicago



with 900 to 3,000 rpm. on direct drive design with 1,800/3,600 rpm. motor and 450 to 1,500 rpm. with 900/1,800 rpm. motor. Belt connected coolant pump is assembled in machine base. Net weight is approximately 1,700 lb., with machine occupying 33x70 in. of floor space, but counting bar feed extension requiring 94 in. beyond the pan.—AVIATION, *January*, 1943

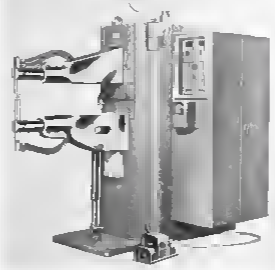
Thread Milling Machines.. .. 34

Hill Bartelt Machine Co., 229 S. Church St., Rockford, Ill., presents two models of a newly designed thread milling machine, one illustrated being single purpose unit. Other is general-purpose machine with adjustment permitting change of set up for wide variety of work. Millers are fully motorized, with all driving elements, also electrical controls and coolant system, enclosed in structure. Single-purpose model can be made up for cutting either R.H. or L.H. external or internal thread, using multiple type thread mill. Feed is by cam governing complete cycle, including rapid return and a dwell for reloading. Coolrols include start and stop buttons for motors, clutch release lever, and clutch-operating handle. With same base element, general purpose model has cutter head with tilting adjustment for aligning cutter with helix angle of thread. Either single or multiple type cutters may be used. With either cam feed or lead screw, machine will cut threads from 5 pitch to 32 pitch up to 9 in. in length with single cutter and up to 2 in. in length with multiple cutter. Controllable cross feed permits cutting of pipe threads or partially tapered threads, states company.—AVIATION, *January*, 1943



Rocker Arm Welder..... 35

Sciaky Bros., 4915 67th St., Chicago, has now introduced a new rocker arm resistance welder, type PMCR 2S16, for spot welding of aluminum and its alloys. Machine embodies features of company's regular line, such as "stored energy with pre-heating and variable pressures with recompression," and also offers several other features, including adjustable electrode tip which may be set at any angle, states the company, without impairing the proper welding position. Settings are designed to make possible welding of unusual shaped sizes of metals. All gages and dials are set on frame of machine fully visible to operator. Machine supplies total pressure of 3,000 lb. between electrode tips from supply line of 90 lb., using normal throat depth of 34 in. It has welding capacity of .080 in. plus .080 in. 24-st. Alclad. Welding stroke is ½ in. and retraction stroke 3½ in. Special face plate at 45 deg. can be incorporated with vertical face plate for special work.—AVIATION, *January*, 1943

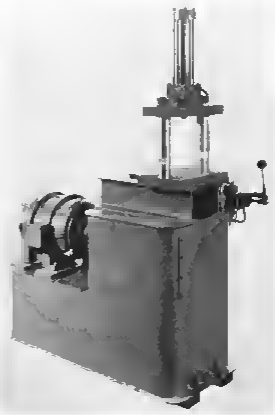


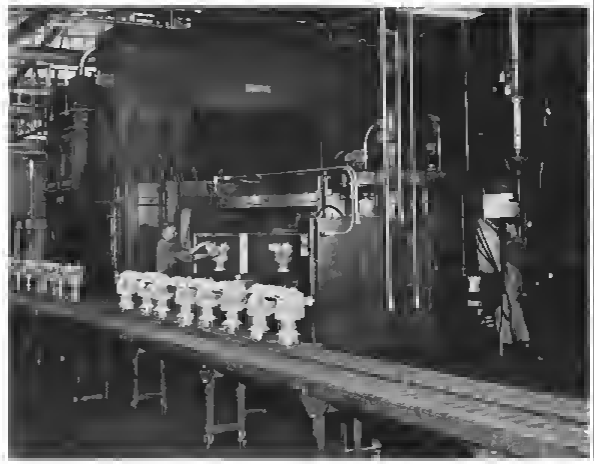
Automatic Airblast Cabinet.. 36

Pangborn automatic airblast cabinet, developed and manufactured by **Pangborn Corp.**, Hagerstown, Md., for use in airplane engine production, puts uniform finish on fins of airplane cylinders prior to their being metallized. Cabinet (photograph below) is designed for time saving in operations giving finish assuring a permanent bond for metal coating. Also developed by company is Pangborn airblast room, a special inclosure wherein entire aluminum and magnesium airframes may be blast-cleaned. Here, fine sand is discharged by compressed air from nozzle in end of hose line, thereby rendering uniform light finish to tubing "without danger," states company, "of deep biting or over-blasting." In operation.—AVIATION, *January*, 1943

Hydraulic Arbor Press.....37

New 6-ton hydraulic arbor press, with 8-in. maximum stroke and affording 20 in. of daylight and an opening of 20 in. from left to right, is announced by **Hydraulic Machinery Inc.**, Detroit. Power unit and press are en unit, former reinforced on top by I-beams, acting as base for assembly. Arbor press and power unit combined occupy 27x42 in. floor space. Directly connected, motor rates 5 hp. on 3-phase, 60 cycle a.c. and





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Wiry Joe, long a leading manufacturer of replacement wire and cable for the automotive industry, is also an important source of supply for electric wire and cable for the aviation industry.

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We are privileged to serve the war effort directly—in the making of important fire-control instruments... Our men and women won their first "E" Award in August 1941—their second in May 1942. It is now our privilege to fly our third flag—the Army-Navy Production Award pennant with two stars affixed. ★ ★ The regular K&E line is also in the service. Mechanical and civil engineers and draftsmen—engaged in war work—make daily use of K&E slide rules, drawing instruments, surveying instruments, drafting machines, tracing papers and tracing cloths.

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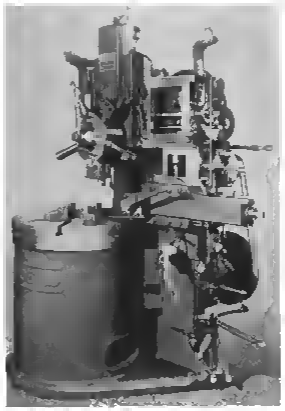


K&E

operate at 1,200 rpm. Press is equipped with manually operated four way valve that is self-centering, and the gage registers from 0 to 2,000 lb pressure. Vickers pump is standard equipment.—AVIATION, *January*, 1943

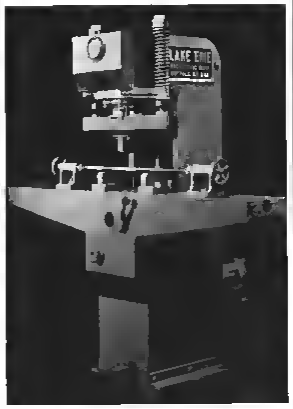
High-Speed Turret Mill..... 38

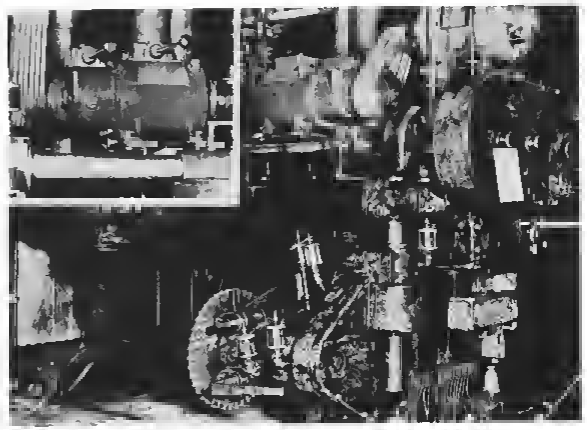
Announced by **Rogers Machine Works, Inc**, 125 Arthur St., Buffalo, N. Y., is new high-speed vertical turret mill designed for boring, drilling, and turning of non-ferrous castings and forgings in aircraft industry. Incorporated are swivel side head adjustable at any angle on each side of vertical up to 35 deg to facilitate quicker tool setting for irregular-shaped pieces, built-in graduated dial to save time in making set-up for original and second runs, and horizontal chuck to permit work to slide readily in exact position. Main drive sheaves runs at 760 rpm., double the 380 rpm. of standard Rogers mill. Like latter, new model has working capacity of 36 in. dia.—AVIATION, *January*, 1943.



Shaft-Straightening Press.... 39

Newly introduced by **Lake Erie Engineering Corp.**, Buffalo, N. Y., is sensitive quick-acting shaft-straightening press complete with anvils and centers for testing. Pumping unit, self contained in base of press, provides 20 tons capacity. Ram operates at high speed and is arranged with quick return spring. Incorporated is combination hand lever and foot pedal control arranged so that either may be used independently. Maximum down stroke of the ram, states the company, is quickly adjusted by control located on yoke, and pressure control hand wheel is conveniently mounted on front of main pedestal.—AVIATION, *January*, 1943





Eight-Speed Transmission.... 40

Capacity up to 30 hp. is offered by Super-motel Transmission. Photo shows installation on Ingersoll planer-type milling machine, while inset depicts close-up of transmission from control side. Made by **Western Manufacturing Co**, 3400 Scotten Ave., Detroit, transmission provides eight changes of speed, arranged in geometrical progression, obtainable through two automotive type shift levers (overall ratio 6:1). Unit is designed to give correct spindle speeds without necessity of stopping machine, thus allowing for complete machine operation and various faces at once setting. Transmission may be used to replace gear boxes on radial drills, vertical turret lathes, etc., as well as for motorizing large boring mills, lathes, slotters, and the like.—AVIATION, *January*, 1943

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HEAVY DUTY



BALDOR Grinder No. 603, ¾ h.p., heavy-duty ball bearing. Capacitor type motor. Guaranteed 2 yrs. against burn-out. 3400 r.p.m., 110 volt, single phase.

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Long before the war started, Mallory Noise Filters helped pilots on commercial air lines to get clear, static-free reception. Thus, when war production became urgent, Mallory engineers weren't caught napping. They had already converted the standard commercial aircraft noise filters into units that meet the toughest requirements of combat planes.

Similarly, other products made by Mallory for the aircraft industry . . . including *electronic parts*, from small tubular condensers to heavy duty rectifiers . . . *electrical contacts* and complete contact assemblies . . . standardized *resistance welding electrodes and holders* . . . have all been successfully adapted, by Mallory electrical and metallurgical engineers, to speed production and improve performance of America's squadrons of the sky.

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Shop Equipment & Accessories

NEW PRODUCTS

Elevating Weld-Positioner 41

Universal Cutter-Grinder 42

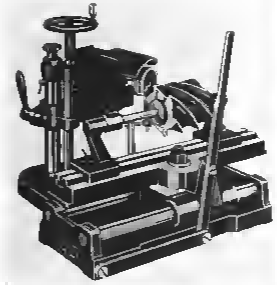
Aircoating Unit 43

Hydraulic tilting and elevating table, powered by motor driven hydraulic pump and capable of revolving in any position mechanically by worm gear



arrangement, is embodied in hydraulic elevating welding positioner made by **Lyon-Raymond Corp.**, Greene, N. Y. Table is easily removable so that welding fixtures can be attached. Unit is suitable for use by women welders through simplifying handling and reducing operator fatigue. Positioner's capacity is 2,000 lb., and round table, which tilts from horizontal to vertical, is 30 in. in diameter with tee slots for ⅝ in. bolts. Included is ½ hp. motor driven hydraulic pump, with motor wound for operation from lighting circuit.—AVIATION, *January*, 1943.

Universal Cutter-Grinder. Barco Mfg. Co., 429 W. Superior St., Chicago, offers new Hilco universal cutter-grinder. Company states that unit, furnished with interchangeable table or flat bed attachment and a special universal index dividing head, may be set up quickly for any other cutter, regardless of type of tool ground last. Dividing head has seven index circles consisting of micrometer placed holes or stops which are designed to assure perfect uniformity with cutting edges in finished cutter regardless of number of teeth or cutting surfaces. A bench type machine, unit is 21 in. long, 17 in. deep, and 17 in. high, with weight of approximately 135 lb. Photo shows unit with table (flat bed) attachment, set up to sharpen helical milling cutter.—AVIATION, *January*, 1943



Aircoating Unit. Paasche Airbrush Co., 190 Diversey Parkway, Chicago, has introduced a new automatic aircoating unit with infra-red preheating oven for applying colloidal graphite compounds to metal parts. Device consists of pressure feed material with necessary hose and fittings, automatic airbrushes mounted on new radial

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A shipment of 2⅜" WD-X4130 rounds was just arriving at one of the Ryerson plants. The car was immediately opened and the same evening the steel was on its way to the airplane builder. A production bottleneck was broken.

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*L*ittle Giaot—Nutcracker—Bulldog...
Such are the oames applied to the Dunco Series 61 D.C. Relays io recognition of their remarkable performaoce io the toughest applications from tanks to airplanes, steel mills or what have you.

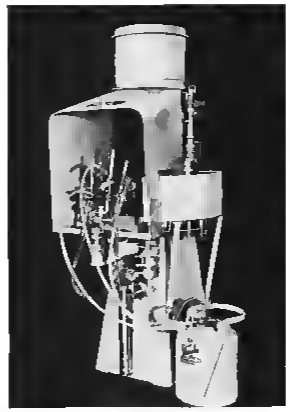
For iostance, ordioary relays weighing one pound may have a contact pressure of 3 or 4 ounces This Dunco type gives 7 *pounds contact pressure in a unit weighing only 8 ounces*—aod is especially designed to withstand intense shocks or vibration and operate faithfully without an eoclosure io dirty or dusty places!

Supplied oo priority orders in various single and double pole types, these aoits are desigoed for D.C. use, although their contacts will also handle A.C. All types are recommended for any low voltage D.C. service where their exceptionally stroog cootact pressure is desirable for securing meximum resistance to shock.

DUNCO RELAYS AND TIMING DEVICES

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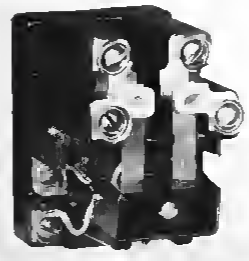
type oscillator, and turntable aircoating unit with exhaust hood and gas-fired infrared oven. Work is placed on hold



ing fixtures which are specially designed for each job Turntable carries work through preheating oven, then after emerging, pieces move in front of automatic airbrushes, which apply the graphite compounds While spraying, guns are oscillated radially, following work to assure uniformity of coverage Basing figures on turntable making 1 rpm, company states average production on 30 in. dia turntable with 20 spindles set at 4-in. centers is 1,200 pieces per hour, while average production on 40-in. dia turntable with 30 spindles set at 4-in. centers is 1,800 pieces per hour Process Engineering Co., Chicago, worked in conjunction with firm in developing formulas for materials used as lubricants.—AVIATION, *January*, 1943

Auxiliary Relay 44

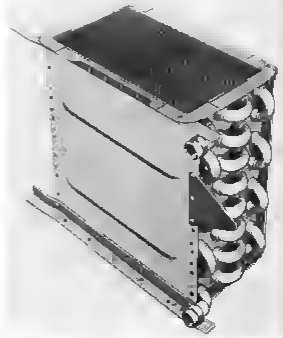
General Electric Co., Schenectady, N. Y., now has new instantaneous auxiliary relay, type HMA, designed to meet light-weight and small-space specifica-



tions of AAF. With its cover, relay is 1⅞ x 2¼ x 2⅞ in. in size and weighs but 9 ounces Offered back or front connected, with or without cover, relay is available in following styles: Double pole, double-throw with single-break contacts; single pole, double-throw with double-break contacts; and single pole and double-throw with double-break contacts brought out to a terminal. Self aligning contacts, states company, will interrupt 1 amp. at 125 volts d.c. inductive load.—AVIATION, *January*, 1943

High-Altitude Heaters 45

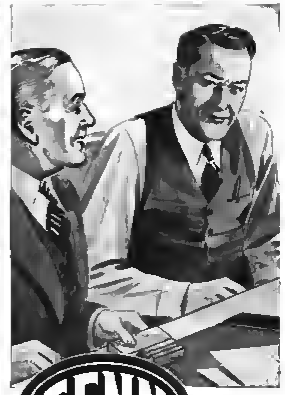
Aircraft heating assemblies to operate at 35,000 ft., where temperature remains in neighborhood of 67 deg. below zero, are offered by **McQuay, Inc.**, 1624 Broadway St. N. E., Minneapolis. Com-



pact units are constructed of aluminum for highest heat *transfer* efficiency.—AVIATION, *January*, 1943

Powered Assembly Jacks.....46

Special jacks for use on aircraft plant assembly lines are announced by **Lamson Corp.**, Syracuse, N. Y. Tail jack (one per plane) and wing jacks (two per plane) are offered. Jacks are self-locking in any position, states company, can be turned in small space, and permit tilting of plane for greater ease in assembly process Couplers to production line conveyor chain are fitted to wing jacks Tail jack has gear-head motor of 1 hp., while wing jack has 2 hp. drive. Maximum lift: Wing jack, 60 in., reversible; tail jack, 73 in., reversible For both type jacks, lifting speed is a 2 ft. per minute.—AVIATION, *January*, 1943



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We have never yet had a Fenn Vise returned to us because of it's failure to perform as represented. Every Vise is built with the greatest precision for accurate work. Sliding and stationary jaws are precision fitted. All working parts hardened ground steel, with heavy duty base of fine grained, well seasoned iron. Why not put the Fenn to a real test in your plant?

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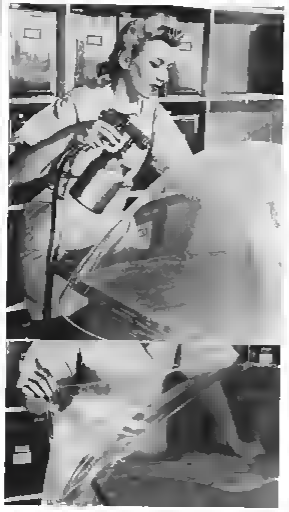
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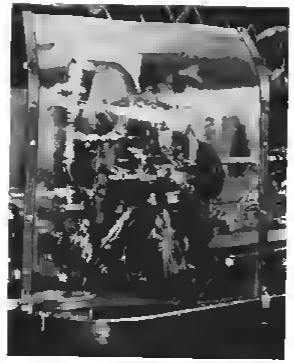
Plastic Gloss Protection..... 47

New, waterproof and abrasion-resistant protective mask for plastic glass bumber noses, windshields, turrets, and windows that is sprayed on and peeled off in one sheet, is Spraymask, announced by **Adhera, Inc**, Los Angeles Product is also suitable for use elsewhere when temporary protective mask or coating against paint, grease, abrasion, wind, or weather is desired. Tough enough to prevent abrasion and ordinary scratches during assembly processes, Spraymask is quickly applied, has no chemical action on plastic, and is impervious to paint thinners and ordinary solvents. When peeled off it tends to clean surface it covered. Its semi-cloudy appearance while being sprayed aids even application, but when dry it is clear and transparent and can be left on as protection until plane is ready for delivery. Photos show application with standard paint sprayer and removal by peeling.—AVIATION, *January*, 1943



Oil-Saving Shield..... 48

Conservation of oil through use of transparent Lamarith plastic shield on automatic screw machines and turret lathes is reported by **Celanese Celluloid Corp.**, 180 Madison Ave, New York City. Fire and safety hazards from spraying of hot oil are also avoided by guard, which sends oil back to drip pans for filtering and re-use. High transparency, light weight, flexibility, and ease of application are features of shield.—AVIATION, *January*, 1943



Insert-Stud System.. 49

Bardwell & McAlister, Inc, Hollywood, Calif, has been licensed to manufacture the rings, studs, and inserts comprising the Rosan locking system of threaded inserts and studs. Method, designed to solve problem of studs coming loose, involves simple ring with serrations inside and out. In practice, stud is installed by customary method, and the serrated ring is forced into place over interlocking serrations built into stud head, making for a tight fit flush with surface of material. Similarly, it is stated that insert developed by Rosan may be locked in place by means of same interchangeable serrated ring. Spline action is basis of positive lock effected by accurate machining. Diagram in accompanying photo shows an insert with locking ring above, ready to drop into place. After ring is broached into material, insert will remain permanently in place, it is stated. Inventor Jose Rosan is seen at right.—AVIATION, *January*, 1943



Tail-Light Flasher.. 52

Application of its constant speed, governor controlled, motor driven flasher mechanism for flashing of red and white tail lights of aircarrier aircraft, is announced by **Wallace & Tiernan Products, Inc**, Belleville, N. J. Maker re-

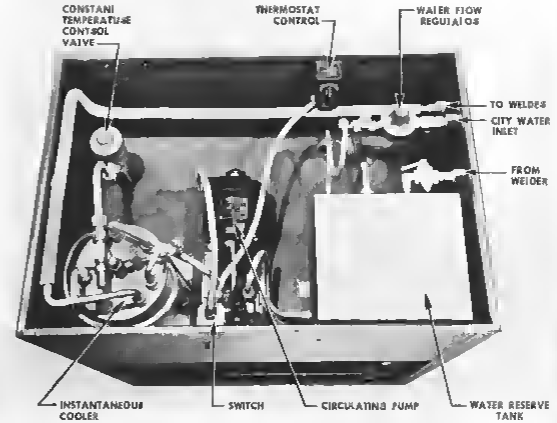


Remote-Control Relay..... 50

B-2-A aircraft relay is new unit offered by **Guardian Electric**, 1614 Walnut St, Chicago. Built to AAF specifications, relay is designed for remote control of aircraft electrical circuits, with contact rating of 25 amp. continuous and 100 amp. surge at 24 volt d.c. Unit, which has single pole, single throw, normally open contact, weighs 6 ounces.—AVIATION, *January*, 1943

Spot-Welder Cooler..... 51

Longer life of welding tips with consequent reduction in refinishing job, also consistent uniformity of weld due to constant tip temperature, are claimed for 550-WC spot welder cooler offered by **Temprite Products Corp.**, 47 Piquette Ave, Detroit. Model is self-contained cooling unit designed to supply constant flow of low temperature water to electric spot welder tip and transformers. Operating as a water circulating system, unit can be used to operate one, two or three separate spot welders, depending on maximum heat load of welders and resistance to flow through the welder water circuit. Cabinet dimensions: Height, 42½ in.; width, 34½ in., depth 23 in. Shipping weight is 500 lb.—AVIATION, *January*, 1943.



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RBC 20th CENTURY NEEDLE BEARINGS

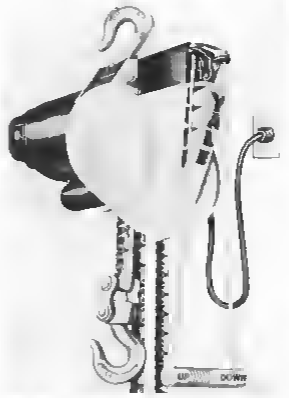
Here's a salute to the Navy's new Grumman Avenger—aptly named—and known for its ability to pay back with interest any damage inflicted by Axis air and surface craft. Here at RBC we get a great kick out of knowing that our bearings are contributing to the fine performance of this versatile job which combines high speed and maneuverability with long range and heavy capacity to throw a scare—and plenty of metal—where it does the most damage.

ROLLER BEARING CO. of AMERICA
TRENTON . . . . NEW JERSEY

ports CAA approval of mechanism as refined for aircraft use. Governor controlled motor, designed to be unaffected by position, vibration, abnormal voltage variation, or variations in temperature from —35 deg to +50 deg C, is stated to hold accurate the exact periods of light and eclipse for 40 cycle per minute flashing characteristics. Unit is totally enclosed in moisture-proof and dustproof gasketed case, with electrical connection through standard A-N type plug. Models are designated as type FA-121 for 12 volts and type FA 122 for 24 volts.—AVIATION, *January*, 1943

Portable Electric Hoist..... 53

Midget King, newly perfected electric hoist, is offered by **Yale & Towne Mfg Co**, Philadelphia Division. Unit is made



to lift capacity loads of ¼, ½, ½ and 1 ton, and hoists are offered in both a.c. and d.c. models. Device is readily portable for quick use on all handling jobs.—AVIATION, *January*, 1943

Tube-Bending Jig..... 54

Now available from **Scott Aviation Corp., Lancaster, N. Y.**, is special bending jig for rapid and accurate bending of high pressure copper tubing for aircraft installations. Jig, which is semi-automatic, consists of hardwood block

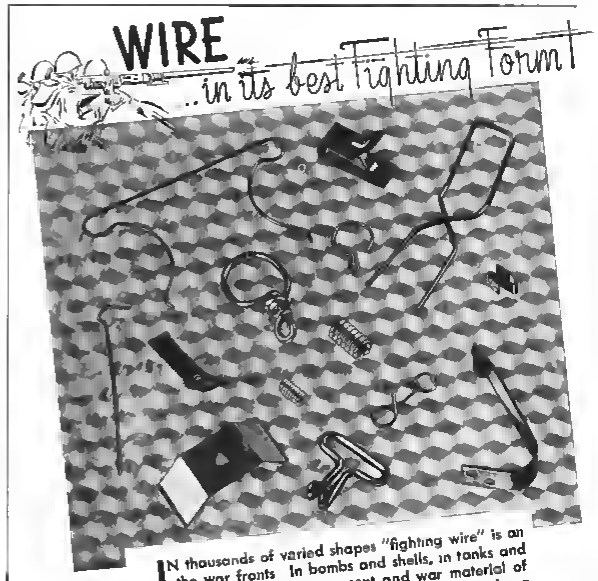


or die (see photo) around which tubing is formed. Actual bending is accomplished by roller and attached handle. Tubing, states company, is rolled precisely to specified shape ready for soldering.—AVIATION, *January*, 1943

Engine, Propeller Service.... 55

Two new lines of equipment for engine overhaul service and for propeller assembly and maintenance servicing, are announced by **Pacific Airmotive**, Burbank, Calif. First developed for use in firm's own shops, both lines are now

offered for commercial distribution. Engine line includes test and storage benches, engine slings, pumping equipment, pre oiler units, and large number of special tools. And more than 100 items are included in propeller line, all manufactured to tolerances well within original specifications. For companies engaged in war program, consultation



IN thousands of varied shapes "fighting wire" is on the war fronts. In bombs and shells, in tanks and guns and planes; in equipment and war material of many types, you'll find wireforms and springs doing a thousand-and-one vital jobs.

Above, you see a few of the many Accurate-made special wire shapes which are parts of fighting implements. They're produced in huge quantities to Accurate precision standards — under rigid control from raw materials to inspected finished products.

Accurate "know-how", based on experience and specialization, can help you solve your production problems that involve springs and wireforms. Tell us what you need and when you need it—it's as simple as that.

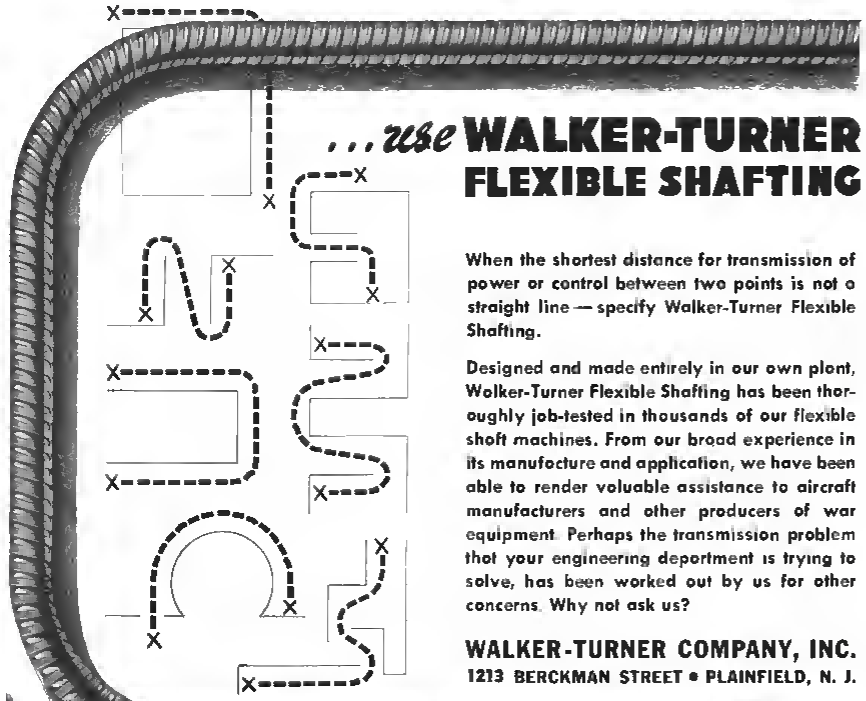
WHAT SPECIAL WIREFORMS DO YOU NEED?

Accurate Springs

Free "Handbook on Springs". Send for your copy today. It is informative, compact, handy to use.

ACCURATE SPRING MFG. CO., 3815 W. Lake St., Chicago, Ill.

When the shortest distance is *NOT* a straight line

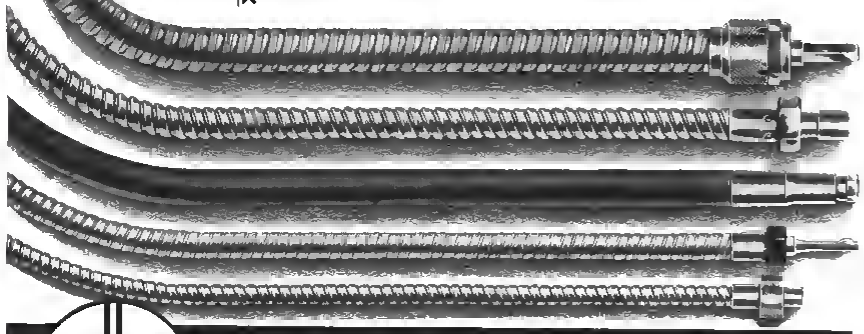


...use WALKER-TURNER FLEXIBLE SHAFTING

When the shortest distance for transmission of power or control between two points is not a straight line — specify Walker-Turner Flexible Shafting.

Designed and made entirely in our own plant, Walker-Turner Flexible Shafting has been thoroughly job-tested in thousands of our flexible shaft machines. From our broad experience in its manufacture and application, we have been able to render valuable assistance to aircraft manufacturers and other producers of war equipment. Perhaps the transmission problem that your engineering department is trying to solve, has been worked out by us for other concerns. Why not ask us?

WALKER-TURNER COMPANY, INC.
1213 BERCKMAN STREET • PLAINFIELD, N. J.



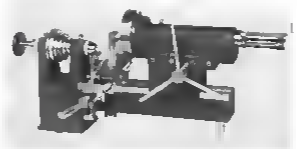
walker-Turner COMPANY, INC. PLAINFIELD, N.J. U.S.A.

FLEXIBLE SHAFTING
FOR REMOTE CONTROL AND POWER TRANSMISSION

service re type and quantity of equipment necessary to service given number of units is also announced.—AVIATION, *January*, 1943

Instrument Lathes 56

New instrument lathes, made by **Powler Mfg. Co.**, 820 S. San Fernando Blvd., Burbank, Calif., are available in two sizes—3/16 in. and ¼ in. bar capacity, both with 9 in. bed and 4 in. swing. Smaller size uses watchmaker lathe col-



lets, while larger employs 9 in. bench lathe collets. Turret revolves vertically, has five stops. Indexing system is designed to give precision in turning to eliminate lost motion. On both models maximum distance between turret and spindle is 5 in. and maximum spindle speed recommended is 3,000 rpm. Smaller unit (illustrated) has handwheel type collet closer, while larger has lever type. For former, maximum power recommended is ¼ hp. while for latter ½ hp. is advised.—AVIATION, *January*, 1943.

Three-Deck Spray Booth..... 57

A large, new type three deck spray booth, 150 ft. long by 30 ft. high, has been developed by **Binks Manufacturing Co.**, 3114 Carroll Ave., Chicago. Three sets of water curtains, one above the other, wash air and carry out fumes and over spray in painting operation. Photo shows installation in Midwest aircraft factory.—AVIATION, *January*, 1943

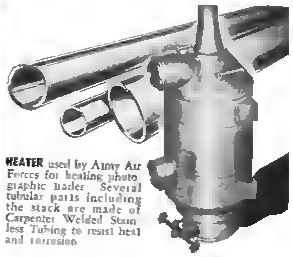
Carbon Dioxide Actuator.... 58

Through a new device developed by **Walter Kidde & Co.**, West St., Bloomfield, N. J., carbon dioxide gas is now used as a source of emergency power. Offered is device known as Power Actu-



ator Cylinder consisting of steel bottle filled with compressed CO_2. Units are connected to pistons of hydraulic sys-





HEATER used by Army Air Forces for heating photographic trailer. Several tubular parts including the stack are made of Carpenter Welded Stainless Tubing to resist heat and corrosion.

HOW THESE
UNIFORM TUBE WALLS
help to boost OUTPUT and conserve metals

The *uniform wall thickness* of this Welded Stainless Tubing permits the use of tighter gauges without sacrificing strength. And *tighter gauges* mean easier forming, cutting and welding . . . an important plus wherever skilled workers are at a premium! Then too, the use of Welded Stainless Tubing, pioneered by Carpenter, helps to conserve valuable metal.

Longer service life is one feature of equipment and parts made from Carpenter Welded Stainless Tubing. There are no thin spots to "give out" as a result of constant heat, corrosion, pressure or wear.

If you would like help in applying this tubing to your design or production problems, let us know. Carpenter's service representatives can help you get the most from Welded Stainless Tubing.



If you use Welded Stainless Tubing, or are planning its use, ask for Carpenter's QUICK FACTS bulletins. A note on your company letterhead will start them on the way—to help you use this Welded Stainless Tubing to best advantage.

Carpenter Welded Stainless Tubing
- *resists corrosion, heat and wear*
- *meets Government specifications*
- *is 100% hydrostatically tested*
- *has a high strength/weight ratio*

THE CARPENTER STEEL COMPANY
Welded Alloy Tube Division, Kenilworth, N. J.

Carpenter
WELDED
STAINLESS TUBING



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On the wer fronts of the world, Hayas Wheels and Brakes fly high — and rate high — with flying men. In wer's roaring tests—as in years of civilian use—flying men know the assurance of accurate ground control that rides with Hayes equipment.

Progress in aircraft design hes found Hayes working with menufacturers, and with civil and military users for years—ready with the wheel and brake components designed for the job.

But keeping pece isn't enough. We are working ahead. Higher landing speeds, heevier loadings, new stresses and balances continually emerge from prophecy to performance. For this future, we are busy developing, testing, proving — busy today perfecting for tomorrow.

ARMY NAVY

Aircraft Men
Know the Reason
For this at our plant

Representatives . . . Western Air Supply Co., 5958 W. 3rd Street, Los Angeles
Eastern J. Henry Reisner, Hagerstown, Md.

HAYES AIRCRAFT WHEELS AND BRAKES . . .

HAYES INDUSTRIES, INC. Home Office: JACKSON, MICHIGAN, U. S. A.

tem used to open bomb bay doors, to lower retractable landing gear, and to apply brakes. When regular hydraulic system fails or is damaged in combat, compressed gas is released into system to operate piston. Each cylinder holds latent force of 30,000 ft./lb. per pound of compressed carbon dioxide.—AVIATION, *January*, 1943

Portable Floodlights 59

To its Circulite floodlight line, **Steber Mfg. Co.**, 2451 N. Sacramento Ave., Chicago, has added new large portable model for floodlighting airports, emer-



gency fields, hangars, factory grounds, and for provision of emergency lighting for night work. Designated as the 1610 series, units employ 300-500 lamps, are adjustable to any angle, have 12-in. chromium plated reflectors, and are supplied with extra long cords for easy portability.—AVIATION, *January*, 1943

Plane Tire for Ice, Snow 60

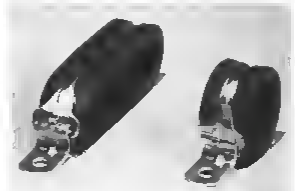
New airplane tire, known as Polar Grip, just announced by **Firestone Tire & Rubber Co.**, Akron, Ohio, is designed



for use by AAF flyers operating from airfields covered with ice and snow. Tire has soft crepe rubber tread with many flexible, finger-like projections to give positive grip on ice and snow and resist side skidding.—AVIATION, *January*, 1943.

Electrical Harness Clips 61

Recent additions to Adel line of support clips and blocks are two electrical harness clips featuring latch permitting temporary fastening to group of wires at desired location, during sub-assembly or jig-assembly, and providing means for holding quickly into final assembly. Lined with Adelite synthetic rubber insulating material to prevent chafing, pressure against living tightens latch and prevents it from opening. Type D 601 (left in photo) is designed to hold three or more wires of 3/8 to 1 1/32 in. diameters in parallel position and is supplied in lengths of from 1 to 3 in. Type D 603



(right) is for securing large groups of varying size wiring. Made by **Adel Precision Products Corp.**, Burbank, Calif.—AVIATION, *January*, 1943

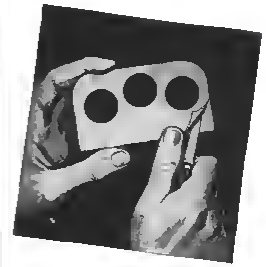
Felt Replaces Rubber 62

Marketed by **Automotive Rubber Co.**, Dept. AV, 8601 Epworth Blvd., Detroit, Thiokol impregnated felt, a non-critical material, is of light weight, making it suitable for aircraft use. Similar in cushioning characteristics to dense sponge rubber or soft molded rubber, product is alternate for critical and restricted rubber and synthetic rubber material. It can be supplied in die cut pads or straight strips for sealing or gasket material.—AVIATION, *January*, 1943.

Aircraft Nut Application 63

Boots Aircraft Nut Corp., New Canaan, Conn., now has self-locking aircraft nut application illustrated in accompanying photo. Depicted is regular

save



twice

THE SAME Laminum shim that cuts assembly time 20 to 30 percent again saves *repeatedly* in making precision adjustments . . . for the life-time of the machine!

Laminum shims— .003 or .002 inch brass laminations bonded into a solid unit (easily peeled)—are cut to your specifications.

Stock shim materials are supplied by industrial distributors. Write us for sample and illustrated shim application chart

Laminated Shim Company
Incorporated
30 Union Street Glenbrook, Conn.

it's LAMINUM
THE SOLID SHIM THAT peels FOR ADJUSTMENT



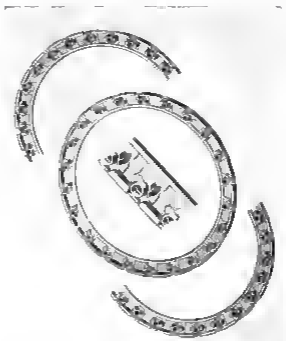


An Armada's in the Making!...

A hundred thousand planes to be built in 12 months. Transports, bombers, fighters—to form the most invincible Armada known. They'll blacken the sky over our enemies and we'll get our Victory and our Peace and our Security.

We need tools—fast, simple, accurate tools to build this Armada. Plane engines must run smoothly—vibrations, stresses and strains must be carefully analyzed, surface finishes constantly checked by men who study these things from graphic recordings as charted by the Brush Direct-Inking Oscillographs and Brush Surface Analyzers.

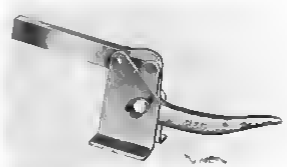
THE BRUSH DEVELOPMENT CO.
3311 PERKINS AVENUE • • CLEVELAND, OHIO



wing-style multiple unit anchor nut (center) in new factory-fabricated circular channel. New assembly is jig-made in factory to give assurance of matching application, and number of rivet holes required is cut down appreciably.—AVIATION, *January*, 1943

Adjusting Jig Clamp.....64

Self adjusting jig clamp designed to be locked in infinite positions up to 15 deg. above or below horizontal have been introduced by **Products Engineering Corp.**, 700 E. Florence Ave., Los Angeles. Ona Pee clamp, as unit is called, will do work of many non-adjustable clamps, states maker.—AVIATION, *January*, 1943.



Electric Cable Connector.....65

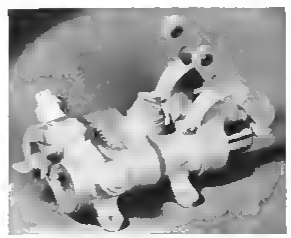
Of three-piece split-shell construction, new electrical cable connector offered by **Harwood Co.**, 747 N. Highland Ave., Los Angeles, is designed to eliminate one coupling nut and one barrel. Company points to greater speed of installation



Size range of these connectors, which conform to Army Navy specifications, is 10S to 48.—AVIATION, *January*, 1943

Simplified Brake Valve.....66

New development by **Aircraft Accessories Corp.**, Burbank, Calif., is simplified brake valve designed for foot-pedal operation of brakes where power is supplied direct to brakes from main hydraulic system through hydraulic accumulator. Valve is interchangeable with



other types of power brake valves. Working units—but two moving parts in addition to lever—are contained in cartridge. Weight for double unit, consisting of two valves in single housing, is

(*Turn to page* 206)

Avoid
SURPLUS SPENDING!



Stop at The Lexington and save—*and put your savings into War Bonds!* More than one-half the total number of rooms in "New York's Friendly Hotel" are now, as before, priced at $4 ... *all outside with combination tub and shower, circulating ice-water, full-length mirror and four-station radio.*

Home of the famous Hawaiian Room

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LEXINGTON AVE., AT 48TH ST., N. Y. C.

TESTORS

AIRCRAFT DOPE

Cellulose nitrate and acetate butyrate, clear and pigmented; also thinner.

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Manufactured strictly according to Army-Navy specifications.

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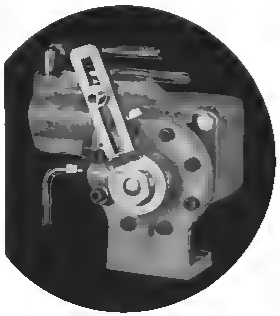
Also: zinc chromate primer, lacquers, enamels, surfacers, sealers, etc.



***Send* FOR THIS FOLDER**
Describes our facilities... shows how we can best serve you

TESTOR CHEMICAL CO., 2300 CHARLES ST., ROCKFORD, ILL.

Now... REMOTELY CONTROL ENGINE FROM TEST BOARDS *without mechanical linkage*



TYPE 550 RRCRIVRR

CASH STANDARD *Remote* HYDRAULIC CONTROL for Engine Test Cells



To operate depress button in control lever with thumb. This releases the Automatic brake. Move the control to any desired position. Release button and control is automatically locked in its new position where it will remain indefinitely

TYPR 550 SENDER

● Type 550 Remote Hydraulic Control has already been approved by numerous aircraft manufacturers and aeronautical laboratories because of improved design that contributes important mechanical advantages and assures dependable results.

It transmits oscillating motion without mechanical linkage. You will find Type 550 of great value in service on engine test cells for controlling throttle position and mixture . . . where it is desired to remotely control the engine from the test boards without mechanical linkage.

Type 550 has positive hydraulic power in both directions . . . no springs . . . no cups . . . no pistons. It transmits the total force applied to the control lever. Pneumatic brake locks it firmly in any position.

Below
ARE THE MECHANICAL ADVANTAGES THAT ARE DAILY BEING PROVED IN SERVICE...

Positive hydraulic power in BOTH directions (has no springs to provide movement one way).

Transmits the total force you apply to the control lever (no cups or pistons).

No lost motion in either direction.

Pneumatic brake automatically locks Control in any desired position, where it stays locked.

No vent line. The hydraulic circuit is filled by operating the control lever from one extreme to the other.

The inlet connection for the brake is ported to the top of the reservoir in the sending unit. This holds hydraulic pressure in the system equal to the air pressure and prevents air from being drawn into the hydraulic circuit by the vacuum produced by any unbalanced load.

There are two hydraulic lines connecting Sender and Receiver, also one pneumatic line for the air brake.

Sending unit is made for table mounting.

Receiver can be installed above or below Sender.

Lever of Receiver can move 90 degrees.

Receiver lever can be indexed to any desired position.

Mounting bracket on Receiver can be indexed to four positions for convenience in installing.

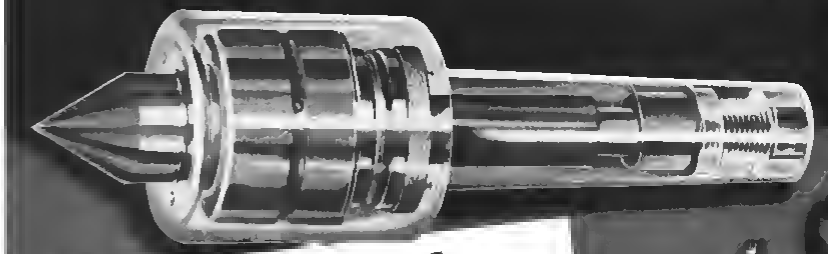
No mechanical linkage.

Write for data and list of prominent users.

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DECATUR, ILLINOIS

CASH STANDARD CONTROLS.. VALVES

MOTOR TOOL
Ball and Roller Bearing LIVE CENTERS



ANY SIZE . . . for ANY USE, STANDARD or SPECIAL . . . we'll make it!

In addition to standard morse taper sizes (1 to 7, inclusive) carried in stock . . .

Precision-built MOTOR TOOL LIVE CENTERS are constantly being developed by our engineering staff for numerous SPECIAL machining operations. Spindles, heads, tapers and points are designed to exactly fit the work to be done. Whatever your needs—standard or SPECIAL—consult with our engineers. Know the speedier production and greater economy of using MOTOR TOOL LIVE CENTERS —the centers that will not burn out or break down no matter how long or how tough the job.



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Please attach letter stating age, occupation employer's name and address and that of at least one business man as a reference.

Screws

Our catalog is no colorful picture book—but it is easy to use and easy to find things in. It was devised for the superintendent, the master mechanic and the purchasing agent.

It is a catalog of standard and special screws — wood or metal — stripped right down to facts and specifications. If you haven't a copy, please send for it now.

MACHINE SCREWS
SHEET METAL SCREWS
MACHINE SCREW NUTS
PLASTIC INSETS
MOLDING PINS
SPECIAL RIVETS

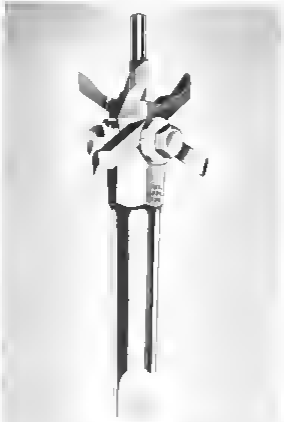
All types of heads and threads

NEW ENGLAND SCREW CO.
KEENE, NEW HAMPSHIRE
INCORPORATED 1892

3½ lb. With proper installation, states company, valve will operate brakes whose maximum working pressure ranges from 175 psi. to 750 psi. Valve is designed for normal use in planes with gross weight in excess of 12,000 lb.—AVIATION, *January*, 1943.

Adjustable Hole Cutter 67

Three blade adjustable hole cutter has been introduced by **Robert H. Clark Co.**, 3424 Sunset Blvd., Los Angeles. This cutter is designed for use in electric



drills, pneumatic motors, drill presses, lathes, and milling machines. They will cut clean holes, states company, ¾ to 4½ in. in diameter in metals, plastics, hard fibers, pressed board or wood in sheets up to ¾ in. thick.—AVIATION, *January*, 1943.

Concrete Floor Conditioner . 68

Compound known as Everecrete, available from **Everecrete Corp.**, 19 W. 44th St., New York City, is a transparent, penetrating liquid for dustproofing, waterproofing, and crumble proofing of concrete. Product is stated to be easily applied to concrete floorings without interference with general business routine. By conditioning flooring, preservative, states company, eliminates menace of sharp silicate concrete dust both to machinery and lungs of employees.—AVIATION, *January*, 1943.

Phenolic Casting Resin 69

Durez Plastics & Chemicals, Inc., North Tonawanda, N. Y., announces a new phenolic casting resin for metal form dies, jigs, fixtures, etc., called

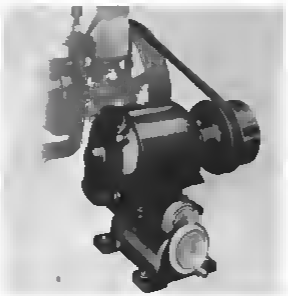
Durez 7421 liquid resin. It is stated that this resin can be readily cast at room temperatures through the use of an accelerator. Cast product is stated to have following properties: Compressive strength, 15,000 to 20,000 psi., impact strength, 0.11 to 0.15 Izod, flexural strength, 7,000 to 9,000 psi., modulus of elasticity (in bending) .5x10⁵. Product is thermosetting material which sets by baking at temperatures above 100 deg. C.—AVIATION, *January*, 1943.

Equalizing Resistor 70

Stated to be light, compact, yet rugged enough to withstand extreme vibration and temperature conditions, a new generator equalizing resistor for 200 amp. generators is now offered by **Avia Products Co.**, 737 N. Highland Ave., Los Angeles. Known as No. 1011, new resistor has been approved by AAF for use in all multi-generator applications.—AVIATION, *January*, 1943.

Variable-Speed Drive 71

Powermatic Drive is name of new variable speed drive with governor speed control produced by **Powermatic Machine Co.**, 659 S. Anderson St., Los Angeles. Speed of unit, states company, may be instantly regulated by increment



of a fraction of an r.p.m. Designed for installation in any position or location common to standard electric motors, unit is designed for accurate speed drive of engine lathes, precision lathes, milling machines, drill presses, and the like.—AVIATION, *January*, 1943.

Spark Plug Tester 72

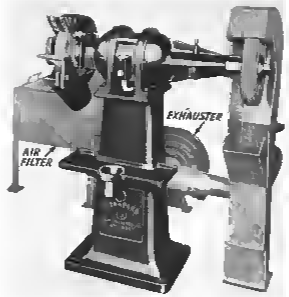
For use as AAF ground equipment, **Danson Engineering Co.**, Columbus, Ohio, has developed a special hydraulic

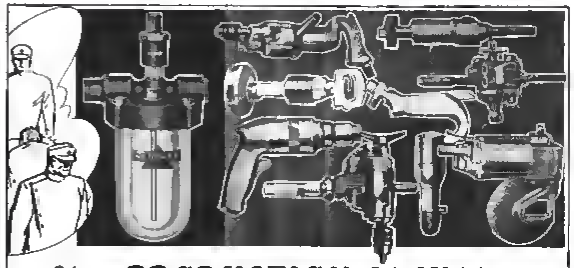


spark plug testing unit. Designated as Model HSPT3, tester develops air pressure up to 750 lb. per sq.in. within 15 sec., states company, maintaining that pressure for at least a full minute, with test time averaging but 30 sec. per plug. Incorporated are high and low pressure air gages, low pressure needle valve, adapters, oil level gage, high voltage connector, low voltage terminal, and foolproof features to assure safety to operator. Commercial aviation adaptation of unit is looked for after the war.—AVIATION, *January*, 1943.

Combined Grinder-Buffer 73

Newly designed combination grinding and buffing machine has been introduced by **Standard Electrical Tool Co.**, Dept. V, 2488 River Road, Cincinnati. Featured in assembly is exhauster equipment for removing and collecting grinding and buffing particles. Spindle is mounted in three heavy duty ball bearings and buffer end is fully enclosed, while tool tray and removable water pot is fitted to front of pedestal. Photo shows 2 hp. machine. Other sizes avail-





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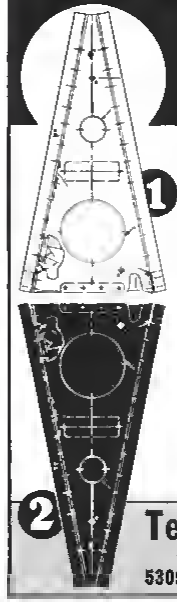
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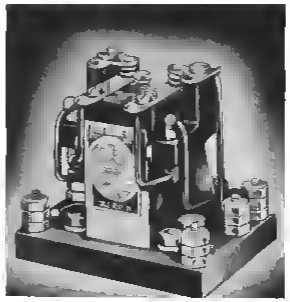
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John Oster Mfg. Co. of Illinois, Genoa, Illinois

able are 1, 3, and 5 hp Dust collecting system is also available in three sizes for application to other grinding, buffing, and polishing equipment —AVIATION, *January*, 1943

Power Relays Re-Designed....74

Allied Control Co, 227 Fulton St, New York City, announces that its BO and BJ power relays for flight, firing, and communications control, have been redesigned to minimize mounting space



required and that new variation in their mounting bases achieve wide interchangeability. Relays are now available with mountings of bakelite, screw or shake proof nut, etc. Photo shows model BOB (model BO with new bakelite mounting) — AVIATION, *January*, 1943

4-Station Hydraulic Press.....75

Announced by **Birdsboro Steel Foundry & Machine Co.**, Birdsboro, Pa., is new 4-station hydraulic rubber pad airplane press, feature of which is arrangement of four seporate loading platforms to permit uninterrupted flow of aircraft parts. Cables can be provided in varying lengths, and loading and pressing operations are fully synchronized and are automatically controlled. Full manual control is also provided for set-up, tryout, and special work requirements —AVIATION, *January*, 1943

Iced-Rivet Dispenser..... 76

Selective automatic rivet dispenser has been designed by **Revco, Inc**, Adrian, Mich, for banding of "bulk" iced rivets in aircraft plants. Rivet can has reinforced metal top and bottom and waxed surface, making it possible, states company, to process rivets from quench, through storage to final assembly line with rivets sealed in protective container, thus eliminating freezing of rivets due to condensation. In operation, size rivet desired is dialed, a button is pressed,



and can of rivets cooled to —30 deg F is dispensed. Model RZ 28 (illustrated) has these specifications: Height 63 in., width 22½ in., depth 26½ in.; dispensing capacity, 120 cans; dispensing rate, 15 cans per minute; selection from 8 columns in magazine —AVIATION, *January*, 1943

Milling Spacer Unit.....77

Straddle-milling spacer, announced by **David J. Ross Co**, Benton Harbor,



Mich, has been designed to save hours of set-up time over conventional type

ARMY TWILL BY REEVES SANFORIZED* REG. U.S. PAT. OFF. MADE TO GOVERNMENT SPECIFICATIONS

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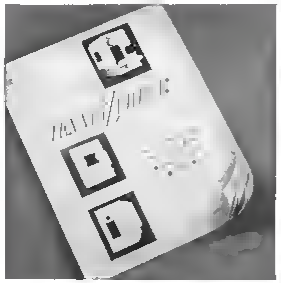
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Known as the Ronsselle "Victory" adjustable spacer, unit is shipped on to arbor, together with conventional type spacer, then is screwed to a setting accurate to .001 in. and locked into position by inner locking ring. Range of five standard arbor diameters (1 in., 1¼ in., 1½ in., 1¾ in. and 2 in.) permits adaptability to all standard milling machines.—AVIATION, *January*, 1943

Lathe Center Lubricant.....78

Joseph Dixon Crucible Co., Jersey City, N. J., now offers new lubricant for dead centers of lathes. Product is



combination of pure flaked lubricating graphite and other specially formulated ingredients made to withstand high pressures and temperatures developed at dead center in lathe work. Lubricant is offered in 1, 4, and 8 oz collapsible tubes.—AVIATION, *January*, 1943

Flux for Gas Welding.....79

Mag-Na Flo, new flux for gas welding all alloys of magnesium, whether sheet or extrusions, is announced by Park Stewart, 1005 Carnis St., Worthington, Pa. Flux is available in glass containers ranging from ¼ lb to 25 lb. In use, it is advised that metal to be welded be painted with flux using small brush.—AVIATION, *January*, 1943

Rigid-Cap Aircraft Relay.....80

Offered by Hart Mfg. Co., Hartford, Conn., is new solenoid type 25 amp. aircraft relay. This new "Diamond-H" unit is built to conform to AAF specifications (type B-2A) and features a rigid cap to protect relay from dust. Low capacity relays of this type are used for remote control of aircraft fuel pumps, landing lights, gun firing controls, and the like.—AVIATION, *January*, 1943

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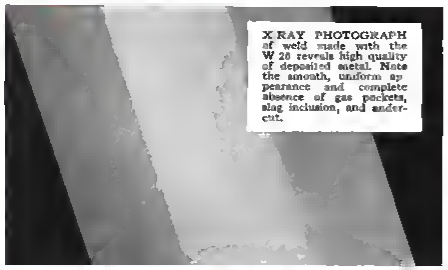
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THE GENERAL ELECTRIC ELECTRODE "W-26"

NOW through the development of the W-26 electrode you can extend the advantages and convenience of *high quality* a-c welding to all positions—both VERTICAL and OVERHEAD as well as flat and horizontal.

Developed by General Electric Welding Laboratories to meet the demands of industry, this a-c electrode complies with the following specifications:

- A W S Filler Metal Specification E6011
- Navy Bureau of Ships, Specification 46E3, Grade 111, Class 1
- A.S M E. Boiler Code, Paragraph U68



X-RAY PHOTOGRAPH of weld made with the W-26 reveals high quality of deposited metal. Note the smooth, uniform appearance and complete absence of gas pockets, slag inclusion, and undercut.

OPERATING CHARACTERISTICS

In operating characteristics and quality of the finished weld, W-26 is superior to other all-position a-c electrodes heretofore available and is equal to the best direct-current electrodes used for mild-steel work. It provides a strong, forceful arc, free from magnetic blow, and enables operators to make finished welds with good fusion and excellent penetration.

PHYSICAL CHARACTERISTICS

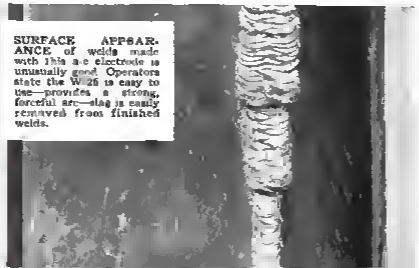
The following table reflects average results obtained from all-weld-metal specimens, tested "as-welded"

Physical Properties of Deposit	5/32 in. Diam.	1/8 in. Diam.
Ultimate tensile strength lb per sq in	72,500	72,000
Yield point, lb per sq in.	60,000	62,000
Elongation in 2 inches per cent	25	25
Reduction of area, per cent	46	46

(The W-26 electrode is now available in 1/4 in. and 5/32 in. diameters. Other sizes, from 1/16 in. to 1/4 in. inclusive, will be made available as soon as possible.)

USERS to whom the W-26 has been submitted report especially favorable results. For example, Mr. R. Kraus, Welding Engineer of Stacey Brothers, Cincinnati, Ohio, says "—with these electrodes average welders can weld vertically and overhead at an equal output as with direct current and reverse polarity. This is a decided advantage for our type of work." Mr. E. H. Dunkman of the United Welding Co. reports "—this appears to be the best all-position a-c electrode we have ever tried—metal lays smooth with little or no undercutting."

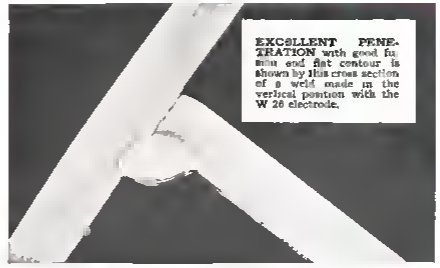
For further information and samples of the W-26 electrode, get in touch with your nearest G E arc-welding distributor or write your nearest G-E office. General Electric, Schenectady, N. Y.



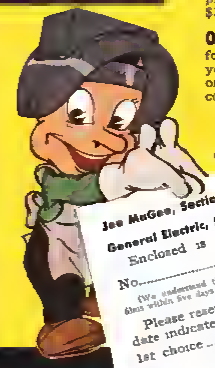
SURFACE APPEARANCE of welds made with this a-c electrode is unusually good. Operators state the W-26 is easy to use—provides a strong, forceful arc—slag is easily removed from finished welds.



FIRST CLASS WELDING in the overhead position is easily accomplished with the W-26 A C electrode



EXCELLENT PENETRATION with good fillet and flat contour is shown by this cross section of a weld made in the vertical position with the W-26 electrode.



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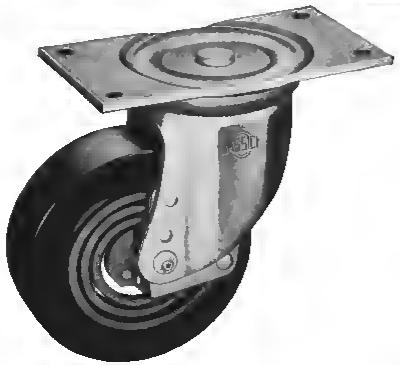
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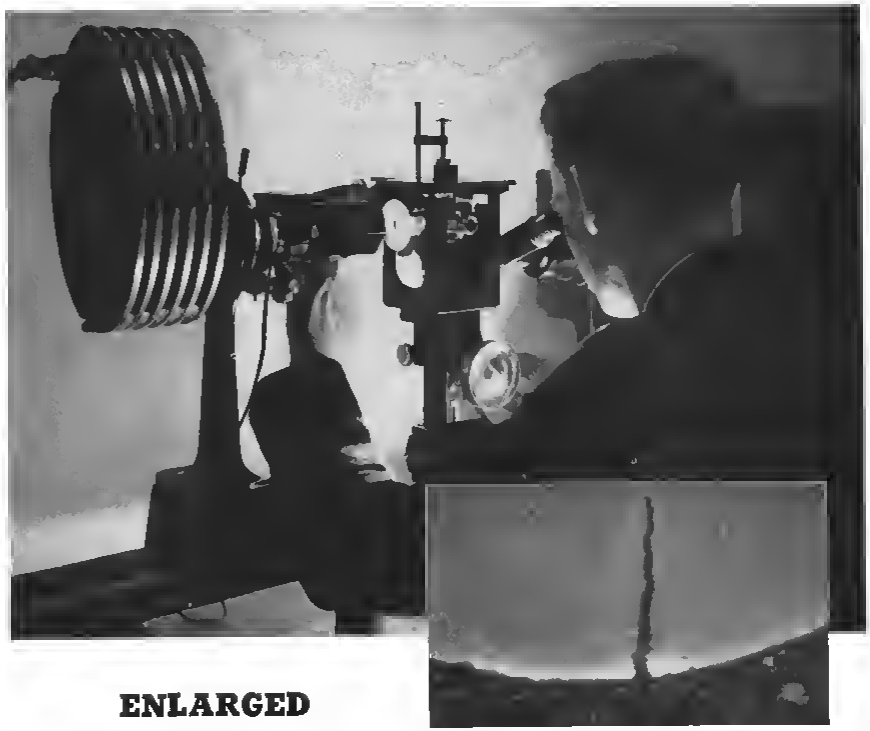
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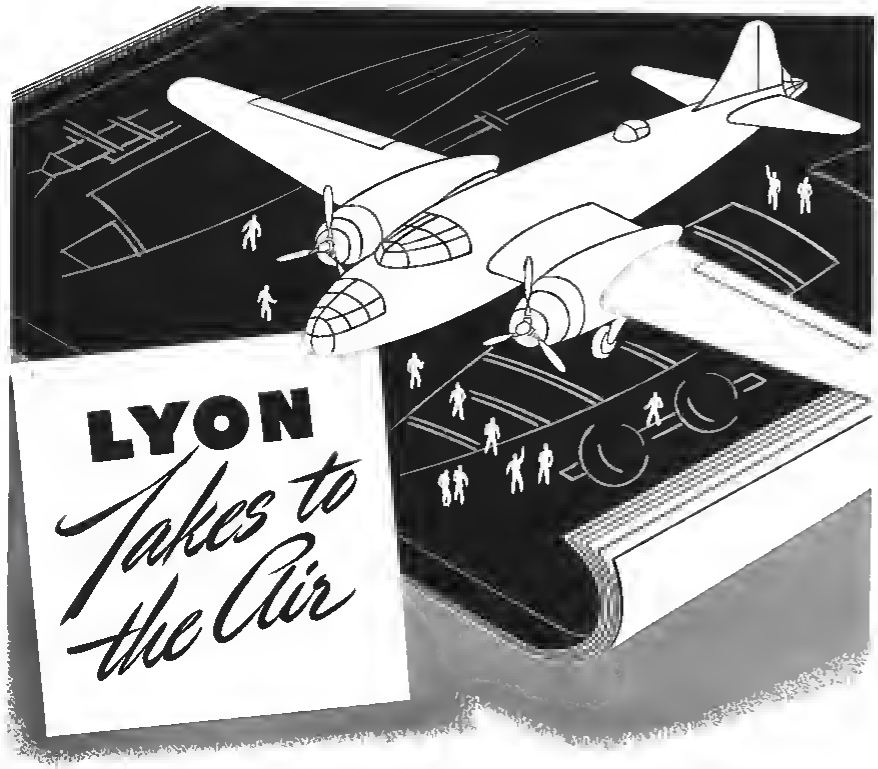
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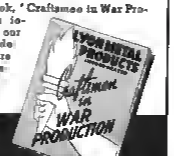
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Our illustrated book, "Craftsmen in War Production" contains interesting facts on our two plants and details of our 43 years of production experience with metal. Write for it.



LYON METAL PRODUCTS, INCORPORATED

Government Aid For Subcontractors

WPB expands scope of Smaller War Plants Division to help small business do its share in meeting the nation's plane production program.

AMERICA'S 1943 AIRCRAFT PRODUCTION goal will necessitate further expansion of the nation's subcontracting program, a fact which will keep the so-called small plant very much in the running.

To give government assistance to such plants, the War Production Board has expanded its activities through the Smaller War Plants Division and the Smaller War Plants Corporation, the latter a fiscal agency set up to give contractual and financial aid to small organizations.

Both the division and the corporation were authorized by the Smaller War Plants Act, which was designed to "mobilize aggressively the productive capacity of all small business concerns and to determine the means by which such concerns can be most efficiently and effectively utilized to augment war production."

In line with this program the WPB has organized the Smaller War Plants Division to offer, locally, the following services to small business concerns:

1. Active solicitation of subcontracts from prime contractors and, where possible, provide potential subcontractors with specifications, blueprints and all other necessary information for such work.

2. Receipt of "procurement inquiries" from procurement agencies regarding items to be purchased on prime contracts, and recommendation of small firms qualified to produce these items to the procurement agencies. In general, firms will be recommended from areas having the preponderance of open facilities adequate for performing the work required.

3. In cases where "procurement inquiries" require the services of groups of firms, "pools" will probably be formed from among those most qualified to handle separate phases of the work.

4. An information service will be maintained to keep small plants informed of all other contract opportunities, procurement and contract procedure and government regulations affecting war plants.

5. Assistance will be given to small plants in obtaining needed materials, machines and labor, necessary to the satisfactory completion of war contracts.

6. Advice and assistance will be given to small plants in obtaining funds for manufacturing facilities and working capital. Loans are made by SWPC, when justified, only after all efforts to obtain financing from banks and other private financial institutions have not been successful.

WPB officials point out that to become eligible for help from the SWPD, all small plant operators should file with their nearest WPB District Office an accurate, up to date record of their manufacturing facilities, and to keep in touch with that office for information on contract opportunities, as well as aid in special situations.

Man And Machinery Available For War Work

136 New York City laboratory and shop, now engaged in subcontract work, has additional facilities for engineering, development and manufacture of special electronic and photo-electric instruments. Equipment includes five 9" in bench lathes and a considerable range of grinding, turret, taper and other attachments, five polishing lathes and specialized instrument equipment. Tolerances of 0.0002 in. can be maintained.

Prime contractors interested in these

(*Turn to page* 219)



Are you interested in: (1) Reducing time and cost of handling tools and materials; (2) Saving floor space; (3) Increasing protection against fire, sabotage and personal injury hazards?

This comprehensive catalog contains many suggestions for meeting these war-time problems. It illustrates and describes many types and sizes of shop boxes, work benches, portable tool stands and many other items that manufacturers of Airplanes and Airplane Parts are finding most effective in every production operation.

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Sales and District Offices Manned by Experienced Engineers in All Principal Cities

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SHOP EQUIPMENT

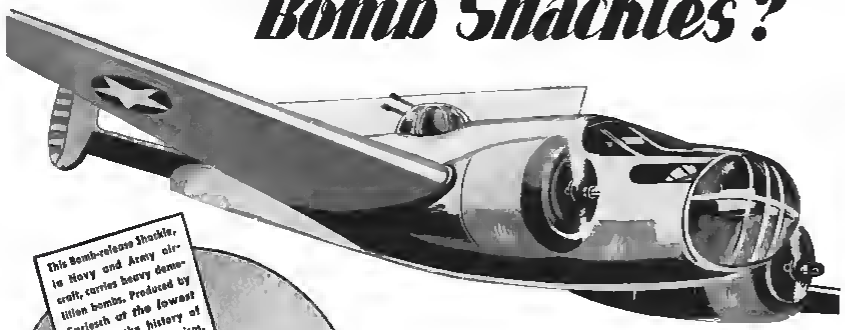
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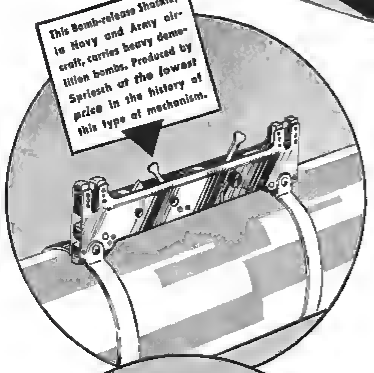
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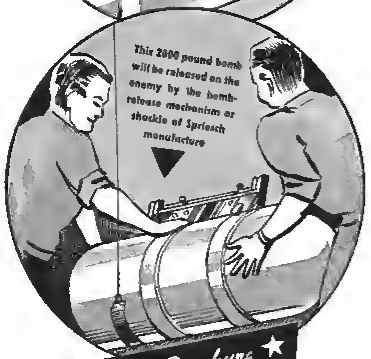
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★ No, that is not a far-fetched question. It is possible thot your future moy be wrapped up in our aircroft armoment, Bomb-release Shackles.

★ Let's look at it this way. Taday we are producing parts for America's wor mochine. Bomb Shackles, made to exact specificotions, being produced 24 haurs a day, 7 days a week. This is war production. In addition our long experience includes serving the U. S. Army since 1928.

★ Out of all this has developed the Spriesch modern war production ability. A production method with the lowest percent of rejectiansi

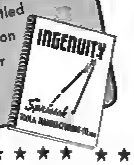
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Our 36-page brochure titled "Ingenuity" will be sent on request Please use your business letterhead



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Typical small parts produced on GOAT 4-Slide Machines From No. 00 to No 3 sizes to handle wire from .065" to 3/16" diameter or strip from .005" to 1.32" thick up to 2" wide. Intricate blanked or formed parts can be produced automatically. GOAT specializes in production of stamped drawn and formed metal parts ranging from .002" to 1/16" metal thickness using all type metals and alloys.

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Division Of THE FRED GOAT CO., INC.
Machinery Specialists since 1893
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SUBCONTRACTORS SECTION

and other facilities listed in previous issues should address their inquiries to AVIATION, 330 West 42nd St., New York, N. Y., referring to the key number listed with each item

Tool Priorities Restricted

Aircraft manufacturing plants, including subcontractors as well as prime contractors, may not obtain priorities on machine tools unless they are operating 135 hr. per week or at least 581 hr. per month, according to a recent government ruling.

Plants engaged in aircraft production but not meeting the 135 hr. per week minimum which present requests for priorities must submit an agreement which becomes an automatic consent to release the machine "at cost to whomever is designated by the Tools Branch, Industrial Planning Section" if the plant does not reach the 135 hr. week within 30 days after receiving the tools.

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cowl walls, muffs, air scoops, supercharger housings and other stainless steel portions of engine nacelles . . . for leading prime contractors.

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Endurance!

TODAY—

In War Time . . .

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Aircraft Mechanics, Inc., the largest manufacturer in the Rocky Mountain area of intricate aircraft forgings, and welded aircraft assemblies builds endurance into every product produced in its plants.

Products built to endure are products which "can take it" . . . in War or in Peace.

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Colorado Springs Colorado

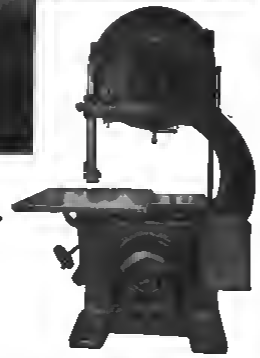


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HIGH SPEED BAND SAWS

With saw blades traveling at better than 2 miles per minute, these machines cut through mild steel sheets up to ¼-inch and non-ferrous metals of greater thickness, either formed or flat, without effort, without vibration—smoothly. On hundreds of different metal cutting jobs they have stepped up production to an amazing degree.

TANNEWITZ HIGH SPEED BAND SAWS are in a class by themselves. Built by sawing machinery specialists, they incorporate many patented features of superiority found in no other band saw. Hydraulic brakes, automatic in case of saw breakage, and complete guarding make them the safest on the market. Get the complete facts by writing for "High Speed Metal Cutting Band Saw Bulletin."



Standard High Speed Band Saw—available with 36" or 42" wheels.

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VARIABLE SPEED BAND SAWS—particularly advantageous for cutting all gates and risers of castings of any metal. Available in sizes to handle castings of practically any size. Write for "VARIABLE SPEED BAND SAW" Bulletin.

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DI-SAWS FOR WORK OF ANY SIZE—They do in minutes jobs which otherwise require hours. Sizes range from our standard 24" throat to 48" capacity. Write for DI-SAW Bulletin.

THE TANNEWITZ WORKS, GRAND RAPIDS, MICHIGAN

"Flying Fortresses"

(*Continued from page 111*)

of the door, which comprises the entire part. Many small jigs, and the time required to put together and rivet the 40-odd pieces has been eliminated.

In these days of manpower shortages, devices which expedite production are of paramount importance, not only in the saving of time for labor but in reversing the adage of "too little and too late."

Exact saving which Boeing tooling has effected in production cannot be accurately determined. But at the *Flying Fortress* factory the number of man-hours required to complete one of the four-engine bombers has been reduced considerably. It is generally conceded that the lion's share of this reduction can be credited to better production methods which have resulted from the extensive tooling program.

For example, metal clips are attached, in numerous places, to the circumferentials of the Boeing *Flying Fortress*. The clips are used to attach lining, small assemblies, installations, etc. Method of locating these clips is through coordinated holes. For quantity production, special piercing dies are developed to locate the holes in the clip, and to locate the holes in the proper place on the circumferentials. In earlier days, during one rush production run, one of the punches broke. The production shop, instead of removing the die for repairs, completed the parts in order, and set up a Perkins punch to locate the missing hole, thinking this the fastest solution to the problem. By referring to the engineering print, the production shop determined that as much as five a tolerance as need be maintained. The tooling tolerance on these holes is plus or minus .0015, and the hole size ⅛. When these reworked parts reached the production jigs, one hole wouldn't match. The number of man-hours required to hand drill the unmatched hole, and complete the job was excessive and even more serious, upset the sequence of assembly operations, thereby delaying production considerably.

Incorrectly manufactured parts can result in abnormally high assembly costs which are difficult to segregate. If a part doesn't fit, the amount of rework on the job which must be done by the assembly shops is almost incalculable, and is never charged against the tool but always to assembly time. While routers and hammer dies can be set up faster, and put into production speedily, the parts are not completely accurate. A little too much pressure on the part of the router operator will cause the drill to lead slightly to one side. If the lag bolts on the router stock are not tightened, the stock may shift during routing, making the blanks of inaccurate size. Seldom can two parts ever approach interchangeability, if made on hammer dies. There is a surprising amount of rework required to make these parts fit with ones which are produced by more accurate tools to closer tolerances.

Nevertheless, these methods which were used for the past several years by the aircraft industry still have a place in the manufacturing of military types of aircraft. There is no method quite so rapid for the development of parts required to incorporate a design change dictated by tactical operations. Boeing uses these tools to incorporate, with a minimum amount of time, changes requested by the air services in the Boeing *Flying Fortress*. Meanwhile, however, better tools are beginning to manufacture these parts with considerable more accuracy—blanking dies, draw dies, or the like.

Tool coordination, planning, and scheduling have an important function in the operation of the tooling department here. It is not at all unusual that 500 tools be required to produce one large, complex part. An engine mount would be a typical example. Having all of the tools finished and ready for production when the part must be made is no small task. This is accomplished by a systematic record which is brought up to date daily, and in some instances, oftener. Load schedules are maintained on every machine, and each shop in the tool fabrication section. By keeping tool fabrication within the tooling department, there is no buck passing. Everyone works toward the common goal of getting out the tools, and making certain that the tools will turn out the parts.

It would be difficult to single out any of the tools as outstanding.

One of the many Boeing developed machines which captured the nation's imagination was the "Octopus," a weird looking hydropunch which notches the circumferentials of the *Flying Fortress* for more rapid joining of the longitudinal stiffeners. This machine can operate up to 19 dies at one time on a radius of 190 deg. The dies are mounted in tracks which will accommodate the diminishing radii of the circumferentials. The outstanding achievement of this machine lies in the fact that it can turn out work 45 times faster than the machine which it replaced. The basic idea behind the machines has proved so successful that Boeing will use adaptations of it for similar machines which are now under construction.

Probably no other machine, from a standpoint of time saving is as important as the Boeing developed automatic spot welder. This is a large table which permits the production department to weld together several panels of aluminum into one side of a wing skin. Moving ½ in. in a small fraction of a second, the welding points make contact for ⅛ of a second, and the machine moves another ½ in. Indexing plates are provided to adjust the spacing between the rows of welds which are made on this machine.

At the present time six of these welding machines are in use in our plant in Washington, there are others in other Boeing plants, while other aircraft manufacturers have adopted this machine for their welding needs.

The tooling job at Boeing has become a task of simplifying production of the *Flying Fortress* so that the army of inexperienced manpower can put together a complex fighting aircraft that will maintain the excellent reputation which has been built up over a period of years by the Boeing *Flying Fortress*. Output of Boeing *Flying Fortresses* at present is four times that of the time of Pearl Harbor. By providing working tools, the Boeing tooling department is aiding in speeding up the output of the fighting tools of victory.

Rocket-Powered Takeoffs

(*Continued from page 100*)

utilize the shortened runway. Gradient runways, for down-hill takeoff, are also being tested. Practicability of these is also questionable, for in modern warfare small emergency fields frequently must be pressed into service, as was the case in Norway, Greece, Malaya, and the Indies.

External launching methods, such as catapults, cable towing schemes, or the Mayo composite aircraft, lack the required ability to be used in large scale operations. As a rule these means require some time for the plane to be brought into launching position, a handicap in an emergency. Then, too, damage to the launching apparatus would materially reduce the striking power of the unit so operated.

Logically, any device or method for assisting takeoff should be incorporated into the aircraft itself. Thus in recent years performance has been improved by better design of propellers, engines, and airfoils, and in some cases by the use of flaps. However, further assistance, preferably in the form of increased thrust during the run, is greatly needed. Boosting the engine's output by the injection of special fuels during takeoff has been the subject of research for some years. It is authoritatively reported that the Messerschmitt 109 is equipped with a tank of special fuel which is fed into the engine in an emergency, resulting in a great burst of speed and clouds of black

(*Turn to page 223*)

STAYNEW FILTERS

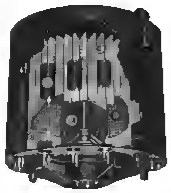
What Does the Name "STAYNEW" Mean? » » » » » » » »

1. Less Wear on Engines and Compressors

2. More Service from Air-Powered Tools

3. Longer Lasting Filters

ENGINE AND EQUIPMENT SAVING FILTERS FOR THE AVIATION INDUSTRY



FOR ENGINE & COMPRESSOR PROTECTION

Models D, DS: Permit only clean, dustfree air to be drawn into engine and compressor intake. Feltex Filtering Medium (S) in Radial Fin Construction (C) provides greatest possible filtering area and efficiency with constant low restriction to air flow. (A) Silencing Chamber (Model DS only); (D) Galvanized Mesh Frame; (E) Reinforcing Tube. D and DS Protectomotors make new engines and compressors stay new—add to life and efficiency of old ones.



FOR COMPRESSED AIR & GAS LINES

Models CF, CFH: Thousands in use throughout the oil industry. Guaranteed delivery of clean, dry air, free from dust, dirt, pipescale, rust, water—air-powered tools operate more efficiently, last longer. Like all Staynew and Protectomotor filters—easy to inspect, easy to clean, low restriction to air flow, long fouling. Models for horizontal and vertical installation. (1) Container; (2) Baffle; (3) Insert Housing; (4) Filter Insert in Radial Fin Construction; (5) Drain Cock.

Representatives in Principal Cities



NEW "SUPER" FILTER

Models AAPH, AAPHS: A newly designed Staynew filter that removes the slightest traces of oil from air transmission lines. Widely used as a final stage in the protection of delicate control instruments. (1) Inlet; (2) Baffle; (3) Solid Feltex discs through which all air must pass. (4) Perforated Liner; (5) Outlet; (6) Shell; (7) Drain Cock. (S) Swing Bolts (Model AAPHS only) for easy inspection.

Get the Entire Story!

Find out about Staynew and Protectomotor engine and equipment-saving features. Radial Fin Construction—Feltex and Glastex Filtering Mediums—*Double* Counter-clockwise Rotating Curtains—Fire-resistant Wire Kladding, etc.

Catalog describes entire line, including filters for building ventilation.

WRITE FOR COMPLETE CATALOG

PROTECTOMOTOR AIR FILTERS

STAYNEW FILTER CORP.

33 Centre Park, Rochester, N. Y. *"Filter Headquarters"*

smoke. Increasing the power output in this manner may be the solution, but it would appear abusive to the engine.

Jet Motors

Experiments with small jet motors, conducted by Dr. R. H. Goddard, the American Rocket Society, and other groups, have proven of sufficient promise to warrant consideration of their use as auxiliary booster motors to function during takeoff or at any other time when a burst of great power is needed. As the duration of functioning need does not exceed 20 or 30 sec., the relatively high fuel consumption of jet motors need not prove a hindering factor. As effectiveness is more important than efficiency in war, the relatively low efficiency of jet motors at low speeds should not preclude their use.

The jet motor is internal combustion in its simplest form, usually consisting of nothing more than a combustion chamber and nozzle. Fuels, usually hydrocarbons, and liquid oxygen are fed in from their respective tanks, under pressure of nitrogen contained in a third tank. Upon ignition, by spark plug or other device, the combustion is continuous and the products of combustion issue from the nozzle at great velocity. Thrust developed depends directly upon the mass flow per second and the velocity of the jet.

Small jet motors, designed for use in meteorological sounding rockets, have already been developed to the point where they may be fired repeatedly without burning out. Better designs tested to date have generated something on the order of 100 lb /sec. thrust per ½ lb /sec. of propellant consumed. Thrusts of over 250 lb. have been obtained from small units. In the opinion of the writer, larger units, capable of delivering 1,000 lb. thrusts, could be developed without much difficulty. By increasing the feed pressures from the present 300 lb /sq. in. to 1,000 lb /sq. in., the jet velocities might be stepped up considerably above the present figure of 6,500 ft /sec. Total weight of such a motor probably would not exceed 25 lb.

As the major weight of such an installation would be the fuel and liquid oxygen, all of which would be consumed during the run, only the light tanks and motor need be carried by the airplane once it had left the ground.

Nazis Using Jacket Power

Reports reaching this country from England indicate that the Nazis are already using "rocket" power to aid exceptionally heavily-laden bombers on their takeoff runs. The Junkers Ju-88 is said to carry an overload of 3,000 lb. by making use of such assistance. It appears that this assistance is in the form of a battery of powerful powder rocket charges attached underneath the belly of the fuselage. These are fired to accelerate the aircraft over the first 50 mph. of its speed range, and they are dropped after using.

Powder Charges

While jet motors, burning liquid fuels, have much more power and offer the advantage of controllability, it might be well to investigate the use of powder rocket charges for more immediate use with present aircraft designs. Powder rocket charges are cheaply and easily produced in great quantities, and they may be transported and handled with less danger than most munitions. Moreover, they may be stored for long periods without deterioration, while liquid oxygen for the jet motor evaporates at the rate of 5 percent per day even in its special Dewar flask containers.

Construction of powder rocket charges has been, for centuries, more of an art than a science. Until recent tests (conducted by the American Rocket Society) with a number of standard commercial powder rocket charges, the actual thrust developed and the duration of firing were unknown to the makers of these charges. Largest of the charges tested weighed but 1.5 lb. of which 0.655 lb. was black powder, the balance being the cardboard cylinder and clay plugs and nozzle. This cartridge developed a peak thrust of 42 lb. at the apex of its sharp parabolic thrust curve. Average thrust came to 16 lb. for 3 sec. A smaller charge, containing 0.406 lb. powder, delivered an average thrust of 15 lb. for 2.4 sec. Extrapolation of these figures would indicate that a charge containing not more than 12.5 lb. of black powder would be capable of developing a thrust of 200 lb. for 5 sec.

An additional thrust of 2,000 lb. for 10 sec. of the takeoff run would materially increase the bomb carrying capacity of our military aircraft. Two batteries of ten charges apiece, of the type mentioned above, would thus be sufficient to deliver this thrust. European experimenters have obtained thrusts of over 600 lb. for 3 to 4 sec. periods from a single charge. The rockets used by Fritz von Opel, in his 1929 pioneer rocket flight, each developed a thrust of 53 lb. for 25 sec., according to reports. The charges were said to weigh 10 lb. apiece. There seems to be no reason then why rocket charges of the 200 lb. for 5 sec. size could not very easily be constructed.

Charges might be slipped into metal tubes contained within a streamlined, sheet-metal container. A single 20-charge battery might be attached under the belly or two 10-charge containers fastened under the wings. Ignition would be effected electrically, firing 10 charges the first 5 sec. and the other 10 immediately afterwards, thus gaining a sustained thrust of 2,000 lb. for 10 sec. After the charges were exhausted they would be dropped from the airplane. In this way no additional weight need be carried by the airplane in flight.

Assuming the individual weight of a charge to be 17.5 lb., then a 10 charge battery need not exceed 200 lb. with container. With more powerful fuels, such as smokeless powder or other nitro cellulose explosives, the weight of such an installation might be reduced considerably. Advantages to be gained would be large in comparison to the cost of such an installation.

Miracle of 1942

(*Continued from page 93*)

Brewster, Curtiss-Wright, Eastern of GM, Fairchild, Republic, and Martin).

As the first-formed AWPC of the Pacific Coast cogently put it: "America's 'secret weapon' is the unselfish cooperation between major industries." Individually and in groups, companies have joined hands to exchange methods of training personnel and systems of producing products better and faster, to loan materials to aid neighbors over acute shortages, to trade laboratory analyses and engineering data once jealously guarded. Synchromeshed has been the Victory system of subcontracting, expanding cooperation to win. Both Councils have joined efforts across the continent. Both are expected later to include not only more plane-making companies but also engine and accessory makers.

The West Coast Council firms are revealed to have reached a combined annual production rate of more than $2,000,000,000. Cooperation since the Council began operations March 15 saw the exchange by these companies of 1,064 engineering reports, 9,119 loans of materials, and all told a reduction of new plane development time estimated at 50 percent.

Likewise outstanding in America's team effort is the work of the Eastern Seaboard Standards Committee, chairmaned by J. T. Thompson, of Martin, the Aircraft War Traffic Conference, handling aircraft makers and automotive builders, headed by W. J. Goehausen, of Curtiss-Wright; the National Aircraft Standards Committee, which has laid the groundwork for setting up dimensional standards in aircraft raw materials sizes.

Meantime, there has been conspicuous and incredible training of "green" manpower and womanpower, the work of the many and varied schools the aforementioned world-fabric of maintenance in the global smash at the Axis—plant experience going to the field, and field experience coming back to the plant.

(*Turn to page 350*)



NIGHT FIGHTER . . .

WONDERFUL organisation by brains behind the scene, initiative, skill and courage of gallant men and—this must not be overlooked—superlative performance by aircraft, all combine to establish the R.A.F. supremacy in the air night and day. There must be no "margin for error" in the performance of high powered aero-engines! They must give immediate response to the pilot's demands, even under the terrific buffeting of battle conditions.

Even in the fiercest dog fight power and speed must be maintained. When engines are "fed" with air, oil and fuel oil free from impurities, they give of their best. That is why on night fighters, battle 'planes, indeed, all types of fighters, spotters, bombers, you will find Vokes Filters in operation. The 99.9 per cent. filtration efficiency claimed for Vokes Filters is not a mere laboratory test bench figure. Vokes Filters, we are proud to say, have proved their value to the fighting forces under the most gruelling battle conditions in the air and on land and sea.

• • •



TOP—VOKES AIR FILTER FOR AERO ENGINES
CENTRE—VOKES OIL FILTER
BOTTOM—VOKES FLAME TRAP SILENCER SPECIALLY DESIGNED FOR NIGHT FIGHTERS

VOKES

VOKES LIMITED • FILTRATION EXPERTS

THE ARTHUR S. LEITCH CO. LTD.
1123 BAY STREET, TORONTO, CANADA
E. CANTIN, 101 PARK AVE., NEW YORK

SHIELDING *for fighters...*



The Pratt & Whitney Double Wasp Engine Illustrated Above is Equipped With

BOLTON SHIELDED IGNITION HARNESS

This 2000 H. P. Double Wasp Engine Is Standard for the *WORLD'S FASTEST FIGHTERS & BOMBERS*

•

In our all-out effort, we pride ourselves on being able to serve the

Army Air Force ***The United States Navy***

Leading Aircraft Engine Manufacturers

•

THE BOLTON MANUFACTURING COMPANY

692 Campbell Avenue, WEST HAVEN, CONN.



The Aviation Industry needs Seed Money

THIS Victory crop is sweet—10,000 planes per month next year seem certain . . . 5,000 per month already passed . . . Worldwide average of four enemy planes knocked down for every American plane lost . . . Jap average five to one . . . Still better planes coming off the line.

And beyond the war, some people see a vast new industrial field opening up for America:

▶ Giant freight and passenger airliners, flying the airocean to every part of the globe, linking our cities in a traffic network that will obliterate time.

Family planes that will jump golfers to far off greens.

What are the chances for this exciting post-war crop of commerce and convenient travel from our aviation industry?

We think the chances are rather slim, and we ask you to take a serious look at the reason.

In our proper anxiety to prevent inflation and control war profits, we have passed tax laws that are taking away most of the "seed money" that aviation companies will need when the time comes to go it on their own in the post-war world.

▶ "Seed money" is that part of profit which is held for re-investment in a business to insure its growth.

"Seed money" will pay for research on new and better products. It will pay for retooling when post-war models are produced It will pay for the study of methods to get the lower costs that widen markets. It will pay for setting up new distributors and dealers, and for hundreds of other activities that are involved in the *growth* of a business.

▶ American industry has grown on "seed money." It has been a national characteristic to re-invest most of our profits in development.

A dangerous confusion between personal profit (salaries and dividends) and re-invested profit (which we have called "seed money") has found its way into our taxing system.

The tax law, and government contracts, should allow American Industry to accumulate funds for the numerous tasks of post-war development.

A sum greater than the total now remaining after taxes will be needed, if we are to take advantage of the new opportunities that will exist after the war.

It is probably the oldest law in economics that enough of each crop must be saved to provide seed for future crops.

Ask your Congressman to see that this economic law is not disregarded in an effort to take excess profits out of war.

Reprints of this advertisement are available in handy booklet form.

McGRAW-HILL PUBLISHING COMPANY, Inc.

330 WEST 42ND STREET • • NEW YORK

Did you ever try to defend a PROFIT?

EVERY business man knows the difference between profit that is paid out to individuals and profit that is held for re-investment and future growth.

The trouble is that the public thinks of profit in terms of yachts, elaborate homes and costly debutante parties. They have learned to think that way because those things get the headlines.

The public does not know that far more profit money has gone back into American business than has ever been taken out for personal spending.

The McGraw-Hill Publishing Company is going to do its share in the job of explaining the difference between these two kinds of profit.

To be sure that the public does not confuse two different things that have always been called by the same name, we have developed the term "Seed Money."

"Seed Money" is explained in the McGraw-Hill newspaper advertisement reprinted on the opposite page. We urge you to read this advertisement carefully and apply its message.

There will be other McGraw-Hill advertisements on this vital industrial need. We hope, too, that other advertisers will adopt the term "Seed Money" and help by selling their employees in their own communities on the danger to living standards in taking away industry's ability to improve its plants and techniques.

* * *

THE McGRAW-HILL NETWORK OF INDUSTRIAL COMMUNICATION

23 publications, which gather "war-news" from the "war-production-front" through a staff of 153 editors and 725 engineer-correspondents . . . More than 1,500,000 executives, designers, production men and distributors use the editorial and advertising pages of these magazines to exchange ideas on war-production problems.

THE McGRAW-HILL BOOKS

Publishers of technical, engineering and business books for colleges, schools, and for business and industrial use.

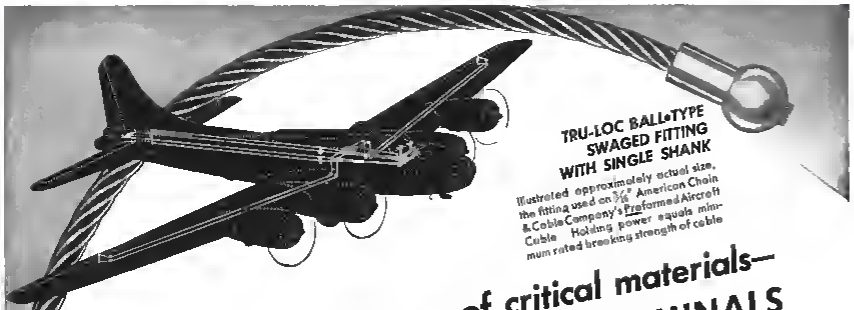
McGRAW-HILL PUBLISHING COMPANY, Inc.

330 WEST 42nd STREET • NEW YORK

Aviation—*(AMERICA'S OLDEST AERONAUTICAL MAGAZINE)—INFORMATION HEADQUARTERS FOR THE MEN WHO DESIGN, PRODUCE, OPERATE AND MAINTAIN AMERICA'S AIR SUPREMACY.*

American Machinist
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AFFILIATED WITH BUSINESS PUBLISHERS INTERNATIONAL CORPORATION, PUBLISHERS OF BUSINESS AND TECHNICAL MAGAZINES FOR LATIN AMERICA, AND OVERSEAS CIRCULATION.



TRU-LOC BALL•TYPE SWAGED FITTING WITH SINGLE SHANK

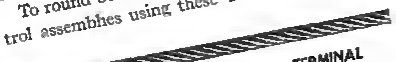
Illustrated approximately actual size, the fitting used on ⅜" American Chain & Cable Company's Preformed Aircraft Cable. Holding power equals minimum rated breaking strength of cable

Avoid excess use of critical materials—
Swing to TRU-LOC BALL•TYPE TERMINALS

From the picture of cable and fitting above you can get the story at a glance—greater ease of handling in close quarters and important saving of weight. The reproduction of the terminal is approximately actual size yet its holding power equals the minimum breaking strength of the cable to which it is swaged.

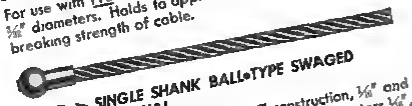
The 3 kinds of TRU-LOC BALL • TYPE SWAGED FITTINGS are illustrated below. The data given may simplify your use of this great advance in aircraft control terminals.

To round out the service, we can supply—to your exact specifications—complete control assemblies using these TRU-LOC BALL • TYPE SWAGED FITTINGS



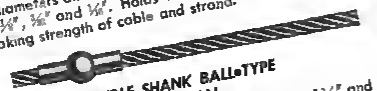
LOAD→ PLAIN BALL•TYPE SWAGED TERMINAL

For use with Preformed cable, 7x7 construction, ⅛" and ⅜" diameters. Holds to approx. 80% of minimum rated breaking strength of cable.



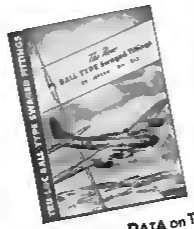
LOAD→ SINGLE SHANK BALL•TYPE SWAGED TERMINAL

For use with Preformed cable, 7x7 construction, ⅛" and ⅜" diameters and 1x19 Preformed strand, diameters ⅛", 3/16", ¼", ⅜" and ½". Holds to 100% of minimum rated breaking strength of cable and strand.



←LOAD→ DOUBLE SHANK BALL•TYPE SWAGED TERMINAL

For use with Preformed cable, 7x7 diameters of ⅛" and ⅜", in 7x19 construction in diameters of ⅛", ⅜" and ½". Holds to 100% of minimum rated breaking strength of cable.



More complete DATA on TRU-LOC BALL • TYPE TERMINALS in the folder illustrated above. A copy will be sent on request.

In Business for Your Safety

AUTOMOTIVE AND AIRCRAFT DIVISION

6-235 GENERAL MOTORS BUILDING · DETROIT, MICHIGAN

★ ★ ★ AMERICAN CHAIN & CABLE COMPANY, Inc. ★ ★ ★

BRIDGEPORT • CONNECTICUT

PITY the poor private pilot—remember him?

Always a hardy soul, he kept on flying despite a raft of obstacles that would have floored the average so-called sportsman. Thousands of his type are doing their bit via the Civil Air Patrol, while others, ineligible for military service, still try to hurdle new, and sometimes intriguing though complicated impediments.

There is, for example, an Eastern flyer who once found his plane an excellent means of keeping a lot of business appointments. Recently, he went out to the field and, on asking to have his ship gassed to capacity, was told he'd first have to see the front office. There he was informed that he'd get 'no gas without a ration book. The board just called to announce the new rule's in effect."

A call at his local board found its members completely in the dark, both on the rule and what to do about it. He was, however, given a non-highway-use blank plus the information that he'd "hear in a couple of weeks." But with a business appointment a couple of hundred miles away, he wanted action — which could only come from the general board, his visit to which used up considerable of his automobile A card.

Well, his request to the board for 600 gal completely floored the clerks—that was a job which could only be passed on by the head man, an acid-faced Legal Mind. "It must be a big airplane," the Legal Mind opined, "to need so much gas."

"No, just a little one—65 hp engine, you know."

"Hmph! Automobiles only have about 20 hp, why not put a smaller engine in?"

That really took some explaining.

Anyhow, the fact that the government would slap a stiff fine on the flyer for such an action seemed to make a much greater impression on the Legal Mind than the fact that the plane wouldn't fly with that little power. Granting that the plane really did need 65 horses to make it fly, the L. M. wanted to know how far the pilot planned to fly these next few months . . . just where was he going that he had to have 600 gallons.

And here said Legal Mind bogged down—proved almost incapable of comprehending why these screwy flyers measured distances by hours in the air instead of using a speedometer. But finally, a ray of light struck—he had it figured out!

"Just how far," the L. M. wanted to know, "do you go in one hour?"

"About a hundred miles."

Fairly jumping up and down in righteous indignation, the Legal Mind wanted to know just who this flyer thought he was . . . why was he so much better than anyone else? "You heard what the President said—you slow down to 35 mph just like everybody else!"

THE STUFF of which hangar flying sessions are made is flowing in—the things that make war incongruous as well as terrible, incidents out of which Americans can get a good laugh but which would leave their enemies completely cold.

There was, for instance, the American pilot who recently heard a scream for help from a crew member who had stepped through the bomb bay and was hanging on for dear life by his numbing finger tips. Holding the ship in the air at the slowest possible speed he headed over a deep snow drift and—without a bombsight—hollered "jump." By the time he had regained flying speed and altitude and made his turn he saw the crew man ploughing his way out, and calmly brushing the snow off.

Then there was the British bomber crew in Africa that had been unable to get to the target. On the run home they let go a stick of bombs just for luck, and caused what they called the granddaddy of all explosions. They hit a Nazi ammunition dump and the skyward hurtling fragments were almost as effective as good anti-aircraft fire.

Or the one about the raid over New Guinea, in which a Boeing B-17 gunner fell, wounded. The radio operator leaped to the gun, which had been loosened from its mounting by a hit. In his frantic effort to turn the piece on the enemy, the operator pulled it clear free and out of the plane it fell. By the one chance in umpteen million, the gun hit a Jap *Zero*, which promptly disintegrated.



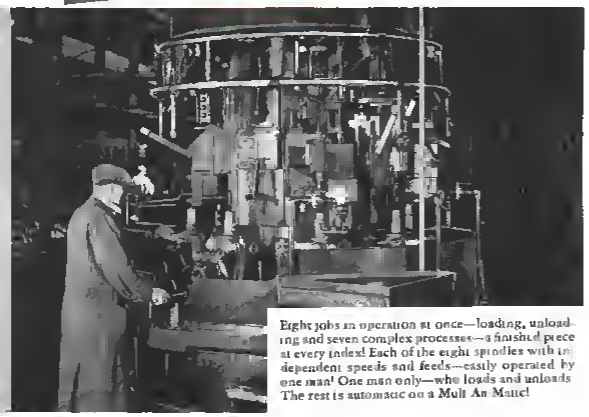
"OPA's cutting Magutre's wings down to 27 inches to clamp a ceiling on him!"

A New and Better Cutting Oil for

ALuminum-MAGnesium ALLOYS

The high output of your Bullard Mult-Au-Matics machining aluminum or magnesium alloys can be raised still further by using Texaco Almag Cutting Oil.

Increased tool-life
Better finish
Less fogging
No offensive odor
Non-irritating



Eight jobs in operation at once—loading, unloading and seven complex processes—a finished piece at every index! Each of the eight spindles with independent speeds and feeds—easily operated by one man! One man only—who loads and unloads. The rest is automatic on a Mult-Au-Matic!

NOT for aluminum alloys alone—not for magnesium alloys alone, but for *both* . . . made especially for the high-speed machining of either aluminum or magnesium alloys. Note well its name . . . *Texaco "ALMAG" Cutting Oil.*

Texaco "Almag" properly cools and lubricates the cutting tools, extending their life, improving surface finish, assuring increased cutting speeds and greater output. *"Almag"* is transparent, and non-irritating to the skin.

The outstanding performance that has made Texaco preferred in the fields listed in the panel has made it preferred by prominent users in the metal-cutting field.

Texaco users enjoy many benefits that can also be yours. A Texaco Engineer specializing in cutting coolants will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distributing points in the 48 States, or write:

The Texas Company, 135 East 42nd Street, New York, N. Y.

THEY PREFER TEXACO

★ More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

★ More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

★ More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.

★ More revenue airline miles in the U. S. are flown with Texaco than with any other brand.

★ More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.

TEXACO

TEXACO Cutting and Soluble Oils FOR FASTER MACHINING

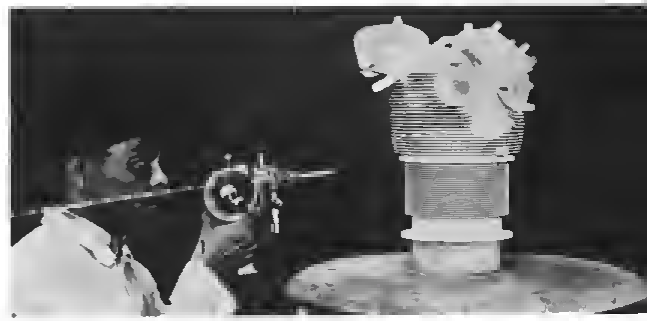
TUNE IN FRED ALLEN EVERY SUNDAY NIGHT—CBS ★ HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

Metallizing for Better Maintenance

MAINTENANCE

By L. E. KUNKLER
President Metallizing Company of America

Versatility and speed make metallizing a maintenance shop "must" . . . worn cylinders, bearings, engine mounts are but a few of the parts which can be put back in service by metal spraying.



Aircraft cylinder being metallized with molten aluminum. Coating fins in this manner protects them against atmosphere and heat corrosion, also increases their cooling effectiveness up to 15 percent. Aluminum wire passes through spray gun from rear to nozzle where combustion of oxyacetylene or propane gas, oxygen, and compressed air melts and propels metal in fine spray against cylinder fins.

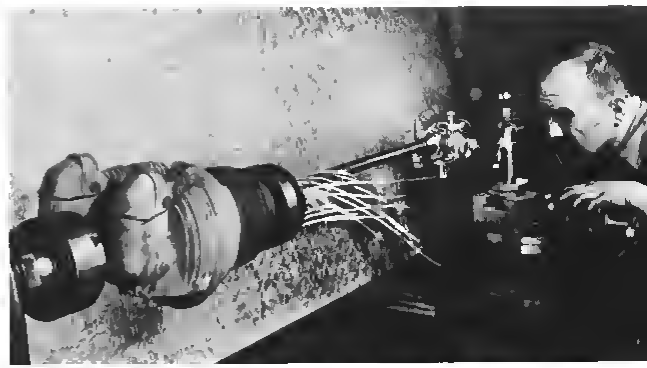
A SURVEY RECENTLY COMPLETED by the Metallizing Company of America indicates that the maintenance departments—and to an increasing extent the production departments also—of America's war plane manufacturing plants are depending on the process of metal spraying as one of the most vital time-saving and cost-saving factors in America's huge war production program.

Important new uses which aircraft engineers are finding for the metallizing process in war plants today reflect a parallel between the rise of metallizing in this war and that of oxyacetylene and electric welding during World War I. Urgent need for faster production and maximum maintenance efficiency during that period pushed welding—then in a relatively elementary stage of acceptance—swiftly ahead to a point which made it so permanently accepted production, as well as maintenance, technique in almost all respects after that war was over. Now metallizing, which, like welding, primarily had its beginnings as a maintenance technique, is finding major recognition in production as well as maintenance through the crises of this World War II.

Of this fact the airplane manufacturing industry and the maintenance shops of the allied air forces offer a particularly pertinent example.

Airplane Maintenance

Let us first consider use of the metallizing process in connection with airplane maintenance. For several years the process has been used very advantageously in replacing metal which has been dissipated by either corrosion or erosion. In the airplane industry this involves the use of aluminum to a major extent. It also involves maintenance of planes which are used in ocean atmosphere, where corrosion is most active. Aluminum on the exposed parts of a plane is attacked and depreciated by the salt-laden air, necessitating either renewal of these parts or application of sprayed aluminum to replace lost metal.



Application of a metallizing gun in rebuilding worn cylinders for Armstrong-Siddeley *Cheetah* engine used in Avro bombers by RCAF. Metallizing solved problem of salvaging thousands of worn cylinders which previously had been discarded.

A good use of metallizing in both maintenance and production is shown in the accompanying illustration of a typical airplane cylinder being sprayed with molten aluminum. The operator is using ⅛ in. diameter pure aluminum



THE *SHADOW* OF VICTORY TO COME

Speed and mobility . . . moving men, guns, equipment and supplies anywhere they're needed, *quickly*. Carrying armed forces to a strategic point, *fast*. Hopping over a terrain that would be slow and tedious work by the ordinary means of transportation. Delivering crack troops to the point of contact without submitting them to the hazards of ground travel . . . this is the job the glider units will tackle to put the "V" in Victory . . . assure America a new freedom—*freedom of the air*.

These 9 and 15 place gliders were designed by Waco and are now built by various aircraft manufacturers under Waco supervision. They will add another thrilling chapter to the record of one of aviation's oldest names . . . WACO.

WACO AIRCRAFT COMPANY, Troy, Ohio.

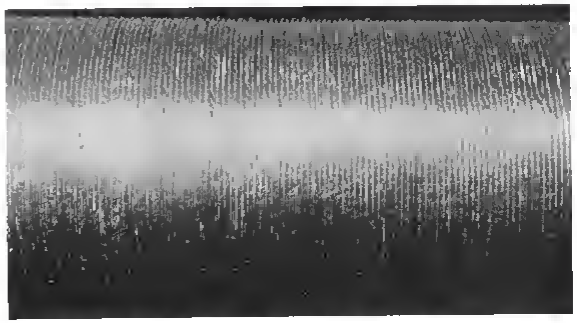


wire and depositing it approximately .005 in. thick on the cooling fins of the cylinder. The process is applied not only on new engines but also for the reconditioning of used engines.

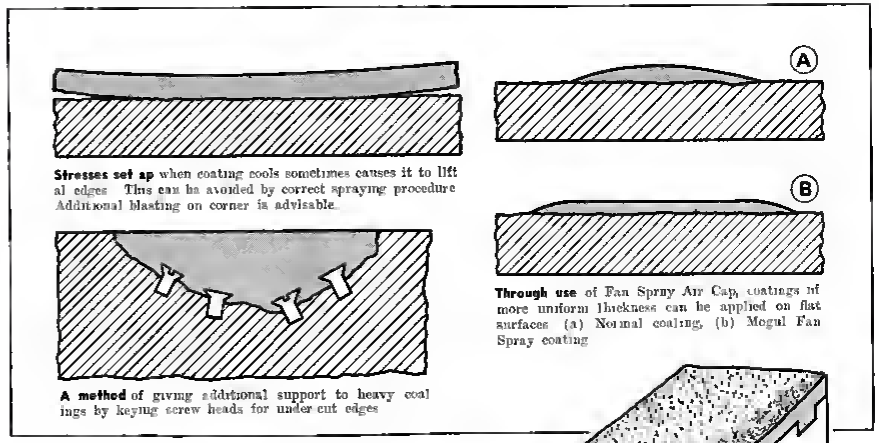
For years prior to this war, metallizing already was regularly used in aluminum-spraying of radiation fins of aircraft engines after each 200 hr. of service. This practice had a dual purpose. First, the fins are comparatively thin, and if not carefully protected against corrosion, would depreciate so rapidly that the life of the cylinder would be shorter. Hence, metallizing to resist corrosion caused by both high temperatures and various types of atmosphere. Second, it is claimed that as aluminum is an excellent conductor of heat, the coating of these fins obtains as high as 15 percent better cooling effect, and therefore relatively greater power efficiency from the engine.

Engine Mounts

Another instance which involves both production and repair is that of engine mounts. Here, we have a tubular structure which is, of course, a vital part of the plane. Tensile strength of these members must be maintained, and the enemy is, again, corrosion. On these parts, the best types of paints have been used to a great extent in the past, usually three coats. In applying three coats of paint, however, the frame must be handled three times, since each coat must be permitted proper drying, and this handling involves quite a large labor cost. In using the metallizing process, from .003 to .005 in. aluminum is deposited in one operation, no dry-



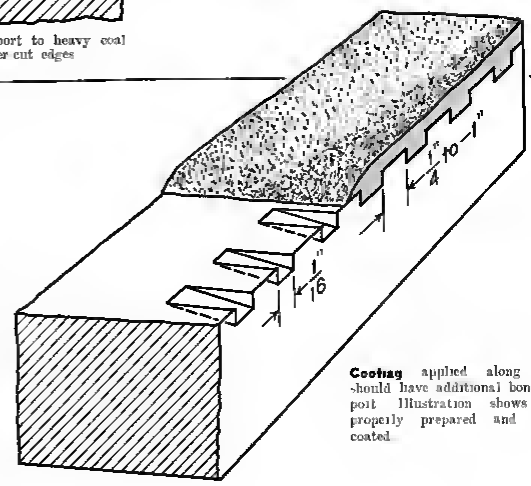
Preparation of rod to be resurfaced by metallizing. Thread is turned on warm surface with tool lathe set slightly off center to produce tearing effect. Molten metal is sprayed into recesses, and cooling locks coating firmly to surface, produces a permanent bond



Stresses set up when coating cools sometimes causes it to lift at edges. This can be avoided by correct spraying procedure. Additional blasting on corner is advisable.

Through use of Fan Spray Air Cap, coatings of more uniform thickness can be applied on flat surfaces. (a) Normal coating, (b) Mogul Fan Spray coating

A method of giving additional support to heavy coatings by keying screw heads for undercut edges



Coating applied along edges should have additional bond support. Illustration shows edge properly prepared and partly coated



A Help on Your Job... Because Chewing Helps the People Who Make the Goods With Which Our Fighting Men Win the War

Chewing Gum's Relief from Tense Nerves, "False Thirst," Saves Man-Hours. Helps People Feel Better, Work Better

Only People Can Win This War!

The machines are vital but they are mere lumps of dead metal without people to run them. People with the will to win—people with high morale and healthy nerves.

Because chewing gum helps the human side of the machine—people—it has taken on a new job—a war job. Scientists have found the basic reasons why chewing helps people feel better, have steadier nerves and work better. They have traced the results in laboratory tests.

And they have found why chewing relieves false thirst—dry mouth and throat that pester workers and send them on "sip-trips" to drinking fountains—even when the body wants no water. And in hundreds of war plants, production managers find chewing relieves the craving to smoke, where conditions make it impossible to permit it. And how it helps lessen fatigue and lifts morale.

Also they find that chewing fights drowsiness, helps keep workers alert and reduces accidents. In these ways chewing gum saves many man-hours now wasted.

And the Armed Forces and people everywhere are finding out how they benefit from chewing gum. That nerve tension is eased and the task goes easier, faster. And so the demand for chewing gum is outstripping our capacity to produce it.

But we are doing our best to get gum to you—in short to get it to the places it will do the most good. That is why we say to you important production people: "If you want to salvage man-hours and help the human side of your machine feel better and work better, see that they have chewing gum on the job, as hundreds of war production plants now do." And we will do our best to get it to you. For only people can win the war.

Wrigley's Spearmint Gum—A Help on Your Job



ing or further handling being required.

Sandblasting for bonding purposes is, in this instance, quite similar to that required for painting, therefore the cost of spraying pure aluminum on an engine mount compares very favorably with protection by painting. Further, it is obvious that pure aluminum will give a much longer service life in resisting corrosion than the very best types of paint. Metallized aluminum for this purpose has been specified on several types of aircraft on production lines. Naturally, it is used even to a greater extent in maintenance.

Solves RCAF Battleneck

Last spring the major bottleneck in Royal Canadian Air Force maintenance concerned the cylinders for Armstrong-Siddeley *Cheetah* engines used on Anson training bombers. In dusty localities, cylinder life was found to be as short as 300 hr. "Cylinder life" in this case meant .010 full taper, since the English makers did not provide oversize pistons, thus the expensive cylinders had to be discarded by the thousands. In desperation, for lack of replacement, many were operated up to a taper of 0.20.

Then metallizing engineers were consulted on the matter of a possible solution. They sprayed two of the closed end type cylinders with extension gun equipment. Cylinders were ground, finished to standard, and rushed through a 25-hr. test. Results created so much enthusiasm that a complete set of seven were ordered metallized for further exhaustive tests.

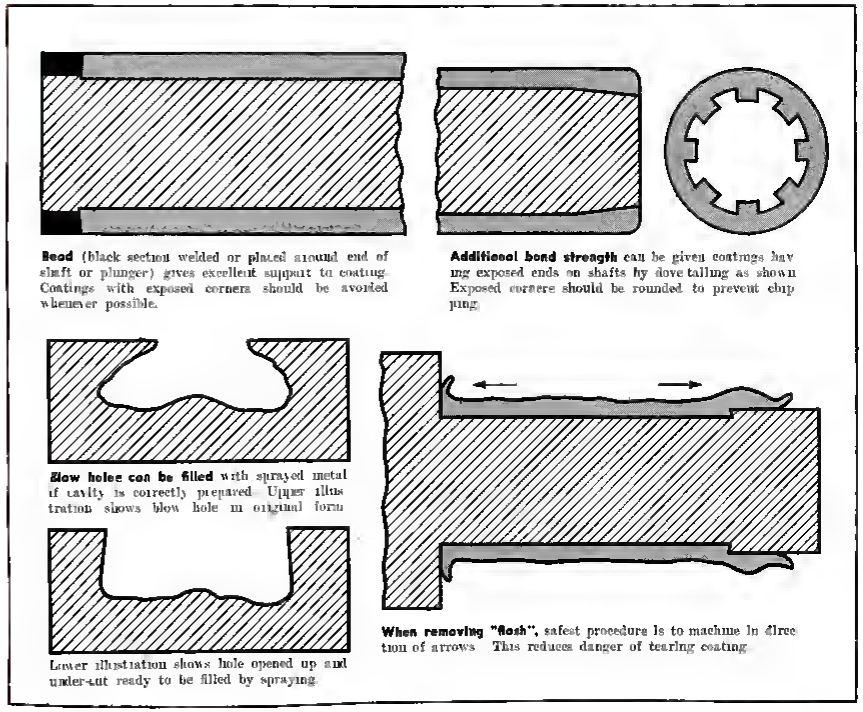
The test run was started on these, and after 25 hr., several cylinders were taken off for minute inspection. Then permission was obtained from RCAF headquarters in Ottawa to resume testing. This had to be done after every examination, for GHQ was evidently skeptical of the outcome and fully expected each examination to show a fault and consequently end the test.

After 100 hr. of test-house run, the cylinders were still as fresh as they were at the start—and "looking for more." So a breakdown test was planned to last 50-hr. non-stop (if possible) with full throttle. Previous testing during the first 100 hr. showed such an abnormally cool motor that cowling had to be put on to obtain the ordinary heat range, demonstrating the antifriction quality of a porous surface. It was also decided to overload the engine with a larger flight propeller.

The resultant data eloquently speaks for itself. Heat range did not come up to that of a normal engine under test with small test-stand prop equipment until cowling was installed, and the bigger prop was used. The strain cut the rpm to a maximum of 1,925 with full throttle. Normal overhauled engines consume oil at the rate of between 4 to 6 lb. per hr. Many exceed this and are rejected. But the metallized engine, under its heavy strain, consumed a maximum of 2 lb., and this amount was showing signs of decreasing as the end of the 50-hr. test neared.

The test ended, the motor was torn down. All seven cylinders were uniform in appearance and condition, with no measurable wear. The last 50 hr. were conceded to equal 150 hr. or more of normal flight. Ring wear was

(*Turn to page 342*)



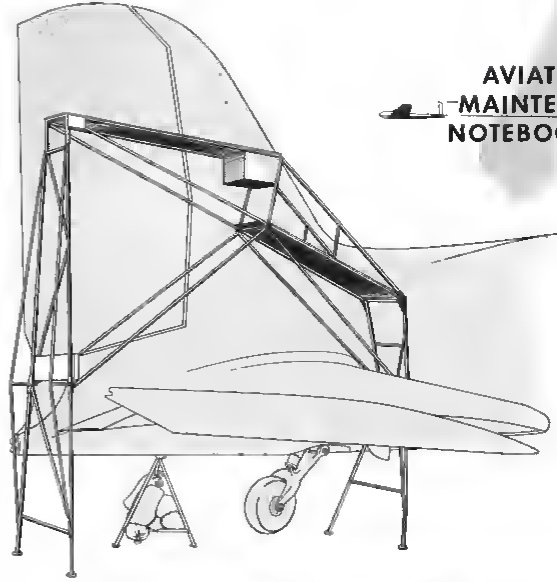
Designed at Chicago and Southern for Grinding Valve Seats

• Fixture and machine for grinding valve seats designed and constructed at Chicago and Southern Air Lines under direction of "Doc" Anderson. Fixture accommodates five cylinders at a time. Main frame is supported at the ends on bearings, the bearing centers being located so that it coincides with intersection of center line through each valve guide and cylinder bore. This permits rotating of this main frame to proper position for grinding of either intake exhaust valve set, with the valve guide in a vertical position. Fixture is also equipped with circulation cutting and cooling fluid for flooding of grinding stone through the unit's valve port opening.

Grinding stones are rotated by a high speed motor, mounted overhead on a track and coupled to the stone spindle through a flexible shaft to the pilot fixture in position over the valve rocker box. Weight of the motor and drive unit is counterbalanced by weights suspended on cables operating over pulleys and connected to main motor support bracket which is guided on vertical tracks. Motor drive assembly can be moved to the respective cylinder assembly by pulling it either one way or the other on the overhead support track. This is a conventional track as used in supporting doors.

To assure elimination of all lines caused by the grinding wheel on the valve seat, a high frequency, air driven, vibrator unit is attached directly to grinding stone guide fixture. This causes grinding stone to be bounced on the seat at high frequency, resulting in a very smooth seat face.

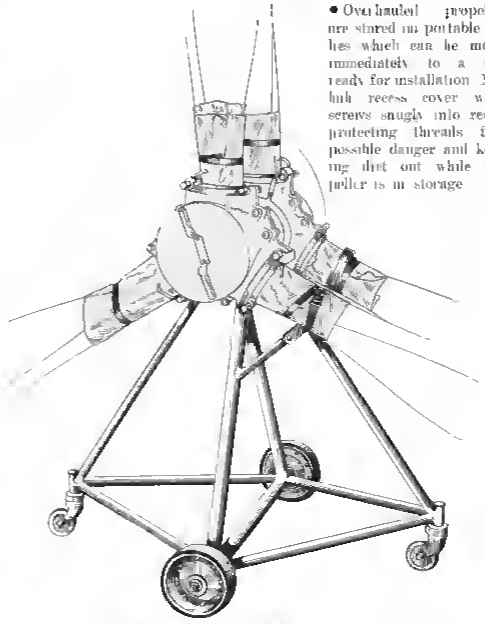




De-Icer Work Stand At American Airlines

• This work stand was designed especially for installation and removal of empennage de-icer boots. Its two inclined platforms enable rigger to work custom of fit from a convenient position. Stand is also useful, however, for general empennage maintenance. It is widely used in American's hangars the year around.

Portable Propeller Storage Unit Designed by United Air Lines



• Overhauled propellers are stored in portable cribs which can be moved immediately to a ship ready for installation. Note hub recess cover which screws snugly into recess, protecting threads from possible danger and keeping dirt out while propeller is in storage.



Jack Stand and Hook-On Work Platform Used at Chicago and Southern Shops

• Hydraulic jack stand built for service and emergency jacking of DC-3's. Also shown is a small work stand hooked to landing gear strut cross-member to facilitate inspection and servicing of retracting mechanism as well as of plumbing and wiring located rearward of firewall and wheel-pit well.

SALT WATER TUFFY



PHOTO COURTESY GLENN L. MARTIN CO

OSTUCO provides pontoon support for this rugged Mariner



Shown above, (in black), is a section of tubing of the type supplied to the manufacturer. Cutting to desired length is only operation required before tubing is made ready for installation.

● It's hard telling just what a bombing expedition holds for sturdy Navy bombers like the one above. At best the strain is terrific whether combat be against the elements or enemy action. Each part must do its designated share. In this particular case it is pontoon supports for which OSTUCO is responsible.

You'll find OSTUCO at a wide variety of critical points in a great many types of both Army and Navy planes. Its strength properties meet exacting military specifications. It is carefully inspected for straightness and freedom from seams, tears, grooves, slivers, scale and other surface imperfections. Whatever the application, OSTUCO's uniformity of strength, dimensions, straightness, hardness and machinability assure that it will fulfill requirements.

THE OHIO SEAMLESS TUBE COMPANY SHELBY OSTUCO OHIO

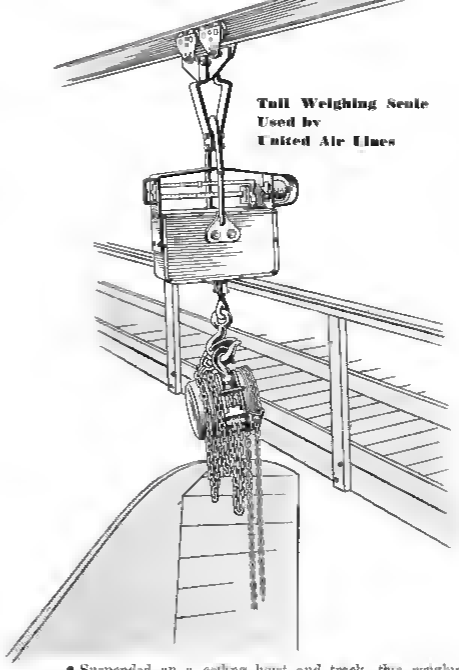


AVIATION'S MAINTENANCE NOTEBOOK

TWA Manifold Pressure Gage Test Apparatus

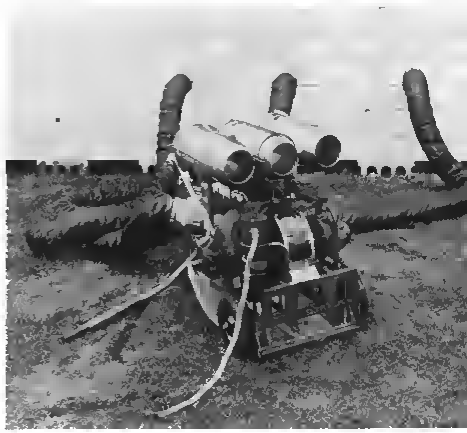
● This test apparatus consists mainly of a quick opening pressure chamber operating in conjunction with a single tube 70 in. mercury manometer. The pressure chamber is connected to the manometer through a system of valves, making it possible to apply suction to the chamber and to the top of the manometer or pressure to the chamber and to the bottom of the manometer. The manometer has an adjustable scale calibrated in both pounds per square inch and inches HG with an adjustable zero index. This makes it possible to set the scale to atmospheric pressure, making the readings correspond to pressure absolute. To make possible the reading of the 70-in. scale, a movable periscope is used which throws the entire scale readings on to an eye-level mirror making it easily readable. This instrument was designated in the TWA instrument overhaul department to rapidly calibrate manifold pressure mechanisms. Additional outlets are provided for the calibration of cartridge type aneroid manifold pressure transmitters, vacuum, fuel, and vacuum pressure and suction warning units.





Tail Weighing Scale Used by United Air Lines

• Suspended on a ceiling hoist and track, this weighing scale can be moved to almost any position in hangar and can be drawn up out of way for convenient storage near hangar ceiling

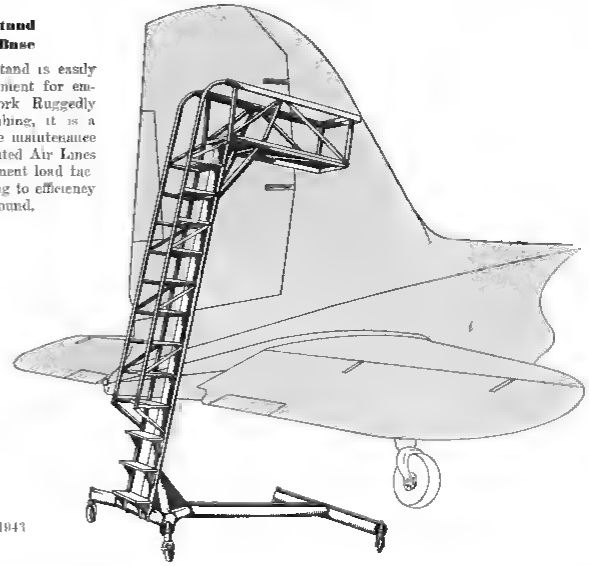


Heating Problem Solved at Chicago and Southern

• Stewart Warner airplane cabin heater now being used for emergency heating of a store house holding modification stock and materials.

Empennage Work Stand At United Airlines Base

• This rudder and fin stand is easily handled and very convenient for empennage maintenance work. Ruggedly constructed of metal tubing, it is a good example of flexible maintenance equipment design in United Air Lines shops where high equipment load factor is an objective leading to efficiency and more rapid turn-around.





THE RADIO-PHONE THAT DIALS ITS OWN NUMBERS

COMMUNICATING with ground stations for commercial transport pilots has now become as easy as "dialing" a neighbor. Using the "BENDIX" RTA-1 Communication Unit, he turns a small frequency selecting switch . . . and the desired communication channel is instantly available.

In addition to the remotely-controlled motor-driven channel selector and accurate crystal controlled frequencies that make this possible, the RTA-1 provides other big advantages. Light, rugged, and built in one compact unit, it weighs less than 75 pounds. The whole unit may be easily and quickly removed for repairs or replacement.

Developed with the cooperation of every major airline in America, the RTA-1 typifies Bendix Radio design superiority and ability to meet out-of-the-ordinary specifications.

The "BENDIX" RTA-1 Communication Unit which combines 10 crystal controlled receiver and transmitter channels with integral power supply into one compact, light weight unit.

THE INVISIBLE CREW
Precision Equipment by
Bendix
AVIATION CORPORATION

The various types of equipment made by Bendix Radio are important members of "The Invisible Crew" . . . the precision instruments and equipment which 25 Bendix plants from coast to coast are speeding to our fighting crews on World battle fronts.

BENDIX RADIO DIVISION

BENDIX RADIO



BENDIX AVIATION, LTD.
HYDRAULIC EQUIPMENT

DOUGLAS "Dauntless" Dive Bombers are blasting the Enemy out of the sea. These airplanes and other American bombers and torpedo planes are striking with telling accuracy at carriers and battleships that stand in the way of Victory.

Bendix Aviation, Limited, Hydraulic equipment and accessories also ride aboard these planes. This is our part of the Invisible Crew that is in service wherever America has met the Enemy.



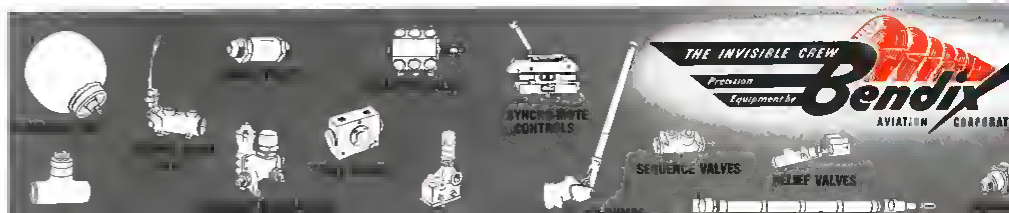
CHECK VALVES

Bendix Aviation Limited Hydraulic check valves have virtually become the standard of the industry . . . in service on the majority of U. S. fighting planes today . . . and engineered into our planes of tomorrow.

They are extremely simple in design and give positive performance over an exceptionally long service life. These valves utilize the exclusive Bendix plastic popper which requires no inserted seat and wears in—instead of wearing out.

Bendix check valves are designed for production as well as performance—they are being produced *today* at the rate of over CENSORED thousand a month—and Bendix has the facilities to accept additional production commitments.

Bendix North Hollywood
SUBSIDIARY OF BENDIX AVIATION CORPORATION





No time for an engine to *Pause for Breath*

One thing a Vought Sikorsky "Corsair" and other high-performance American planes need above all else is constant, positive power. Regardless of altitude, attitude or speed, their engines *must* have correctly proportioned, finely-mixed fuel and air. "BENDIX-STROMBERG" carburetion provides just that, under *all* conditions of flight.

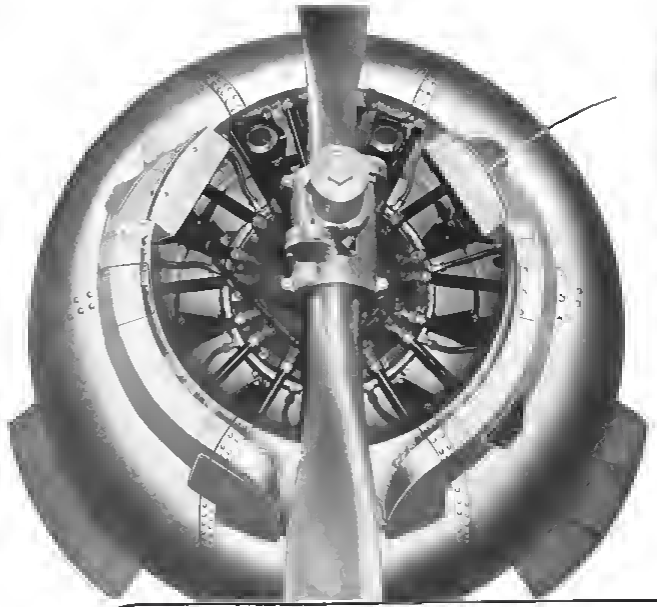
Neither rarified air nor sudden twists, turns or dives interfere with the certain, continuous functioning of the "STROMBERG" Injection Carburetor. Automatically compensating for changes in flying conditions, this intricately designed yet ruggedly built unit provides the correct mixture at all times.

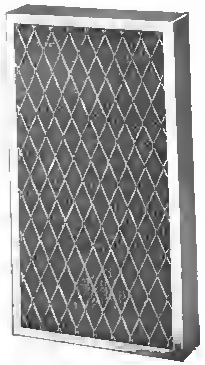
Vital aids to both all-out fighting power and fuel-saving flight, "STROMBERG" Injection Carburetors are today serving on United Nations fighters, bombers and reconnaissance craft in every quarter of the globe.

The "STROMBERG" Injection Carburetor is a vital member of "The Invisible Crew" . . . precision instruments, and controls, which 25 Bendix plants from coast to coast are speeding to our fighting crews on world battle fronts.

THE INVISIBLE CREW
Precision Equipment by Bendix
AVIATION CORPORATION

BENDIX PRODUCTS DIVISION





Phantom view shows AAF filters and clean air ducts to engine intake installed directly behind cowling ring.

Two AAF filters, type shown above, are employed in this installation.

This Airplane Engine breathes CLEAN AIR!

More than twenty types of AAF airplane engine filters are being made today for United Nations planes. These were developed in cooperation with aircraft engineers to meet varying airplane construction requirements as well as Army Air Corps specifications.

Complete information and performance data are available without obligation. Please write us.

AMERICAN AIR FILTER COMPANY, Inc. **346 Central Avenue, Louisville, Kentucky**

In Canada: DARLING BROS., Ltd., Montreal, P. Q.

AMERICAN AAF AIR FILTERS **AIRPLANE ENGINE FILTERS**

KEEP UNITED NATIONS PLANES FLYING LONGER

Task Force . . . On any front, no flight group will take off with better assurance of getting there first than the elite pilots selected to fly *Republic P-47 Thunderbolts*, the only airplanes known to have been propelled through space at the almost incredible diving speed of 12 MILES PER MINUTE!



REPUBLIC AVIATION

REPUBLIC AVIATION CORPORATION — FARMINGDALE, L. I., NEW YORK

Flight Strip "Hows" and "Whys"

MILITARY

Easily and quickly built, convenient highway-side runways augment our defense and training, expedite ATC services, promise to promote postwar civil flying. Here are revealed details of site-selections, design, and construction at these flight strips.

SAD LACK of comprehensive airfield facilities put a No 1 strain on our domestic aero endeavors in the years immediately prior to the war Air mail, passenger, and cargo business was then recording an estimated overall "up" of about 40 percent per annum Civilian flying was also in a steep climb

And when military activities—with all their training, maneuver, defense, and ferrying phases—were superimposed, the strain became No 1-plus. With the accent on that plus! Hence, the flight strip program, backed by two $5,000,000 appropriations.

Fact is, the flight strip plan is revealed to be more than domestic. Today, it is reaching beyond our borders to aid the world wide service of our Air Transport Command In one case of overland operation on a foreign route which without doubt will be vital in our '43 war effort, flight strips are now augmenting the few available airfields. Easily and quickly constructed, the strips are greatly expediting the flow of men and materials to critical zones.

Flight strip practice has now been detailed by Fred E Schnepfe, special engineering consultant to the Federal Works Agency Administrator and director of the Flight Strips Division, Public

International News photo



Nation's first flight strip "somewhere on Middle Atlantic Seaboard" Opened for operations last summer, it measures 8,000 ft by 500 ft, has 8 in concrete runway 7,000 ft long by 150 ft wide Note paved "tail" (top) which links strip with main highway, facilitating vehicle transfer of people and freight.



In the Rooms where Technicians are Made

Those men with Technician's chevrons on their sleeves are the real McCoy. They are the fellows who keep 'em fit to keep 'em flying. In their classes, they get the inside story of every part. And when it comes to filters, they usually hear the familiar instruction: "Keep it Clean with Purolator!"

Eighteen years ago, Purolator invented the oil filter. Today the name is synonymous with filtration. Fortunately, this pioneering attracted other manufacturers to this field, so that today, the combined production supplies oil, hydraulic and air filters for all our 'planes, tanks, naval vessels, merchant marine and all the other mechanized equipment plus new elements for civilian cars.

A catalog showing complete details of current Purolator aircraft filters for air, lubricating oil and hydraulic oil is available to responsible officials on request.

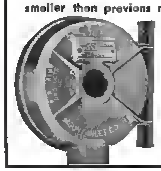
Purolator also places at your disposal for consultation and development work, its staff of experienced Filtration Engineers. Over the years, these men co-operating with the Engineers of a great majority of aeronautical, automotive and marine manufacturers have been able to design many special air, oil and hydraulic filters for unusual requirements.

Know the Technicians



The New PUROLATOR PA-12 Air Filter for VACUUM OPERATED INSTRUMENTS

This filter is a decided advance—40% lighter and 35% smaller than previous models. The reduction in size and the increase in design efficiency are accompanied by a new application of Purolator's extended area design . . . to Purolator's patented plastic impregnated wood cellulose filter elements. Tests prove the PA-12 removes solids down to three microns from air . . . even at temperatures of minus 68°F. and plus 160°F.



KEEP 'EM FLYING LONGER WITH

PUROLATOR

PUROLATOR PRODUCTS, INC., Home Office: Newark, New Jersey
California Office: 1401 South Hope Street, Los Angeles
Founder, Builder and Leader of the Filter Industry

Roads Administration.* For the "ground work" development of this supplementary landing area idea, Mr. Schnepfe credits Col. Stedman Shumway Hanks, who after years of campaigning advanced the flight strip scheme before the Subcommittee on Safety in Air, Commerce Committee, U. S. Senate, in 1936.

Plan is for each strip to be constructed adjacent to (never integral with) a public highway, with a short link built between the two to facilitate local auto transport. Strips, naturally, need not be parallel to such highways.

Purpose of these single-runway strips are two-fold: First, there is recognition of the folly of concentrating large numbers of aircraft on primary air bases where they would be vulnerable to enemy action. In brief, the strips augment our active bases while affording a means of dispersal of craft.

Second the plan looks to postwar increases in civilian and transport flying—sees it promoted by the strips, which will provide civilian flyer facilities, offer auxiliary utilities to transport craft, or afford air-feeder service for small cities or groups of towns.

Maintaining liaison with the Army Air Forces, with which it fully cooperates in the program, the Flight Strips Division is responsible for location, design, and construction of the strips. Under the Division's direction, district engineers of the Public Roads Administration seek out sites, later care for surveys, plans, estimates, bids, awards of contracts, and supervision of construction by various state highway departments.

The Division's manual of procedure and design was drafted after concurrence with the AAF, which has exercised the responsibility of selecting projects best integrated with needs. Proposed sites have been examined by boards of one or more officers named by Commanding Generals of the Air Force Areas in question, following which the PRA district engineers have drafted key reports detailing convenience of sites, air distances from nearest aero bases, prevailing winds and other weather data, information regarding obstructions, soil, and drainage, and estimates of costs and time of construction.

Usually, an area averaging 100 sq. mi. is designated on a map by the AAF, with any location therein deemed suitable. This latitude has simplified selections.

Naturally, each strip area, with its own specific topography, drainage, soil, available surfacing materials, and other local conditions, presents a different problem. Operational need of expected traffic is largely the criterion of design, with consideration, meanwhile, of vertical, horizontal, and side clearances, length and width of the runway, and the gaging of shoulders, end zones, and approach areas.

Roughly, the approach zone to the strip's runway is a trapezoidal area 500 ft. wide at the end of the runway extended, and 4,000 ft. wide at the zone limit two miles distant. Within this area,

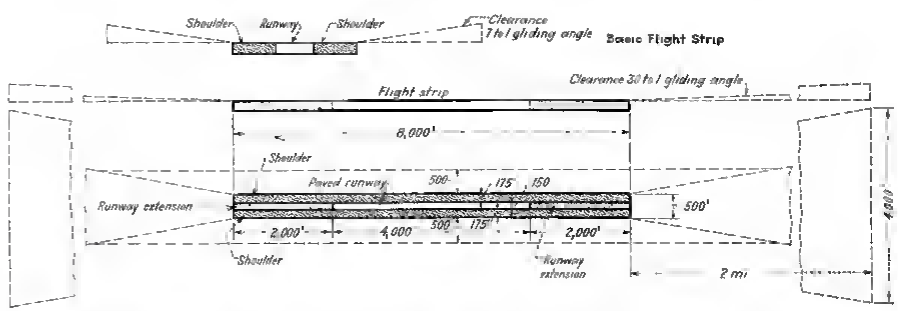
(*Turn to page* 324)



Army Air Forces photo

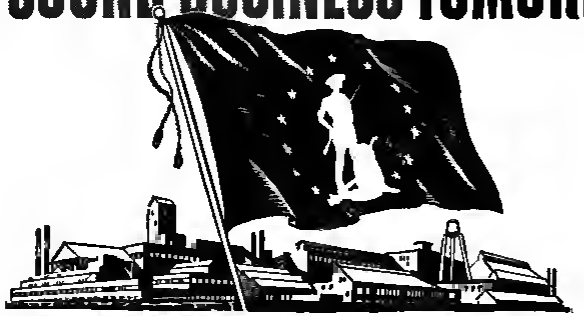
Retouched cowntryside—not retouched photo. This view of first strip, snapped prior to construction of link with highway, illustrates how land is acquired and "aero-improved." Paved "nubs" at runway ends are for turning of aircraft preparatory to takeoff runs. Neighboring highways may be seen at lower left and on right.

* To paper entitled, *Flight Strips—Present and Future*, presented before ASCE Fall Meeting, Niagara Falls, Canada, Oct. 15.



Vivcolized in this AVIATION diagram are the elemental flight strip specifications, as detailed by Fred E. Schnepfe, director of PRA's Flight Strips Division. It is pointed out, however, that topography of the selected site, height above sea level, operational needs, etc., are criteria in deciding a strip's final design and dimensions. Projections show gliding-angle clearance areas.

FOR VICTORY TODAY AND SOUND BUSINESS TOMORROW



Get This Flag Flying Now!

This War Savings Flag which flies today over companies, large and small, all across the land means *business.* It means, first, that 10% of the company's gross pay roll is being invested in War Bonds by the workers voluntarily.

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AVIATION



A BETTERMENT . . .

Not a Substitute

The old hand-pumper is now a museum piece. Today, fire-fighting is just as much a science as farming, industrial production or fighting

The modern chemical fire extinguisher is certainly never considered a substitute for the old hand-pump It is a betterment.

Into its development and perfection have gone many materials not known in the hand-pumper days. Continental-Diamond NON-metallics are among them. Just as C-D NON-metallics have helped make modern chemical fire-fighting equipment a "betterment," they can answer definitely your "What Material?" problem.

C-D NON-metallics possess many desirable properties not found in habitually used costly, heavy, corrosive materials . . . NOW so hard-to-get. When C-D NON-metallics are properly designed into your products they will make possible "betterments" that you will not want to give up

You'll never want to go back to the old hand-pump days.

The C-D folder will give you complete basic data on FIVE C-D NON-metallics. When you are ready for action write, wire or phone for a C-D Laboratory Research Engineer. Ask for folder GF-14

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How to step up aircraft production

Airplanes and parts move along assembly lines in the skyways *faster* are constructed with *greater efficiency* conform to military and naval standards and specifications *without exception* — when you apply the tested, improved processing procedures, given in this practical manual. At each step of the way—whether the work has to do with procurement of materials, identifying them, riveting, welding, heat treating, finishing, testing, etc.—you can get better production, solve your problems quicker with them.

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PROCESS PRACTICES in the AIRCRAFT INDUSTRY

By Frank D Klein, Jr.

Senior Metallurgist, Materials Control Branch, United States Army Forces, Formerly Associated with North American Aviation, Aviation Manufacturing Corp Stinson Division, Vultee Aircraft

266 pages, 6x9, 46 illustrations

69 tables only $2.75

This handy book supplies you with complete, authoritative facts about preferred aircraft process practices.

Written by a U S. Army Force specialist for aircraft workers, it covers all essential materials and gives detailed explanation of the best methods of processing them. Technical design process requirements and practical production test methods for control of quality are included

Designers, draftsmen, inspectors, maintenance and construction chiefs will find in this practical manual just the kind of day to day information most frequently needed in aircraft production work

Set new production records by using the processes described in these 23 detailed chapters

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4 Magnesium and Its Alloys
5 Steel
6 Fabric Covers Cloth Tapes, and Threads
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8 Chemicals
9 Organic Finishes
10. Standard Aluminum and Aluminum-alloy Rivets and Methods for Riveting
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Standard Drill and Ream Notes
Standard Thread Notes
Characteristic Bend Radii
12. Design Process Requirements for Aircraft
13. Protection Use of Zinc Chromate Primer
14 Cleaning and Preparation of Aircraft Metal Parts Prior to Application of Protective Coatings
15 Heat Treatment of Aircraft Steels
16 X-ray Inspection of Castings and Forgings
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Men at the "stations"—radio, navigator, bombardier, pilot, co-pilot, gunners tell us they like Murdock Radio Phones—they're so comfortable and *reliable.*

Jimmy Doolittle wore Murdock Radio Phones on his last trip to Tokyo. And he will wear them on his next trip

Would you like to see this deluxe Air Corps headset? Send to Dept 22 for catalogue.



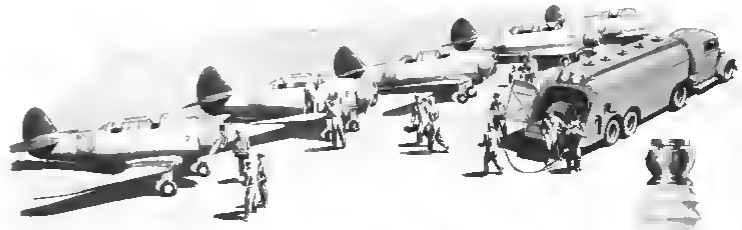
Murdock

RADIO PHONES

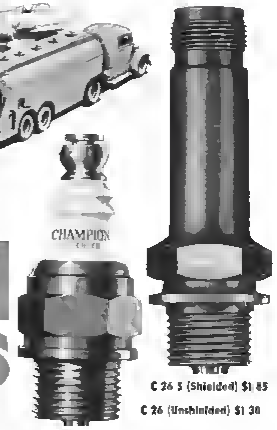
Used by the Army Air Corps

MURDOCK MANUFACTURING COMPANY

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CHAMPION Ceramic Aircraft SPARK PLUGS



C 26 S (Shielded) $1.85

C 26 (Unshielded) $1.30

MORE VITAL—MORE DEPENDABLE THAN EVER

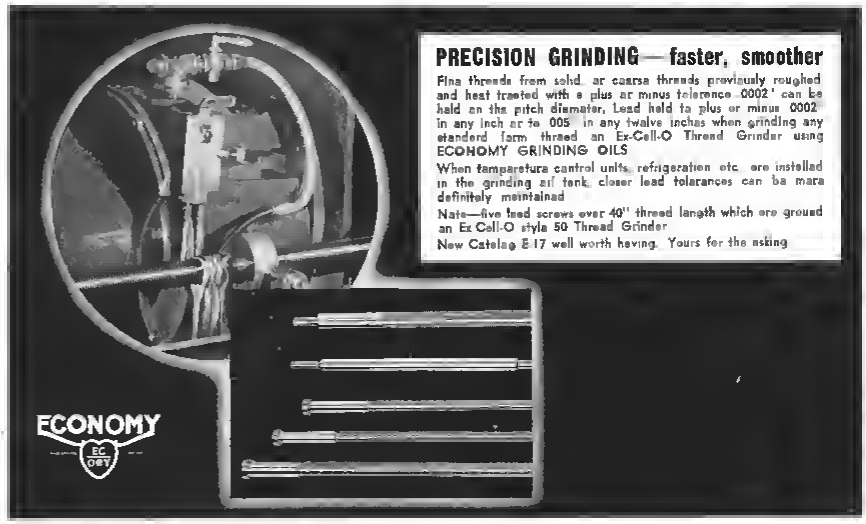
Field service reports are coming in regularly—unfortunately not for quotation—showing remarkable service records for Champion Ceramic Aircraft Spark Plugs in aircraft of every size and type being used by the Air forces of the U. S. Army and Navy. Unprecedented long life and extreme dependability sum up these records which are directly due to the unique characteristics embodied in Champion's new ceramic insulating material.

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Characteristic Advantages of Champion Ceramic Insulation Are—

1 Immunity from heat and chemical reactions
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Install Champions and fly with confidence



PRECISION GRINDING—faster, smoother

Fine threads from solid or coarse threads previously roughed and heat treated with a plus or minus tolerance .0002" can be held on the pitch diameter. Lead held to plus or minus .0002" in any inch or to .005" in any twelve inches when grinding any standard form thread on Ex-Cell-O Thread Grinder using ECONOMY GRINDING OILS

When temperature control units, refrigeration etc. are installed in the grinding oil tank, closer lead tolerances can be more definitely maintained

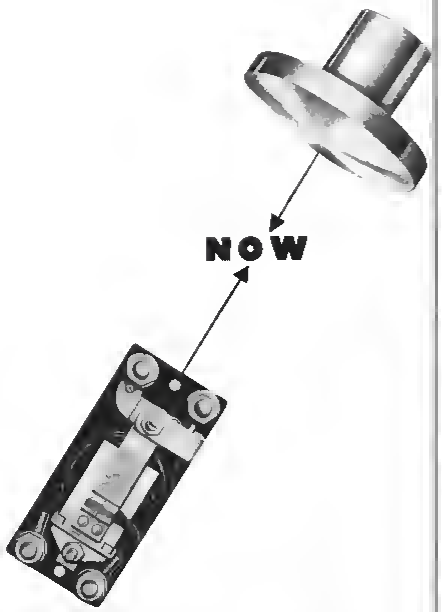
Note—five lead screws over 40" thread length which are ground on Ex Cell-O style 50 Thread Grinder

New Catalog E-17 well worth having. Yours for the asking

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There s an interesting application story ried ro the Ward Leonard relay illustrared above However, mum s the word and the story will have to keep until afrer Victory But, it s no military secter, thatWard Leonard, one of the country s oldest and largest manufacturers of electric controlling devices, uses Callite Contacts.

This ts but one of many unusual applications in which Callite Contacts are contributing their proven reliabil ity If you have a problem in contact maretials or design, Callite Engineers will be glad to cooperate with you Catalog No 152, describing the complete line of C T screw, rivet and welding type contacts is now available Callite Tungsten Corporation, 545 Thirty ninth Street, Union City, New Jersey Branch offices in Chicago and Cleveland.

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INDUSTRIAL AIR LINE EQUIPMENT

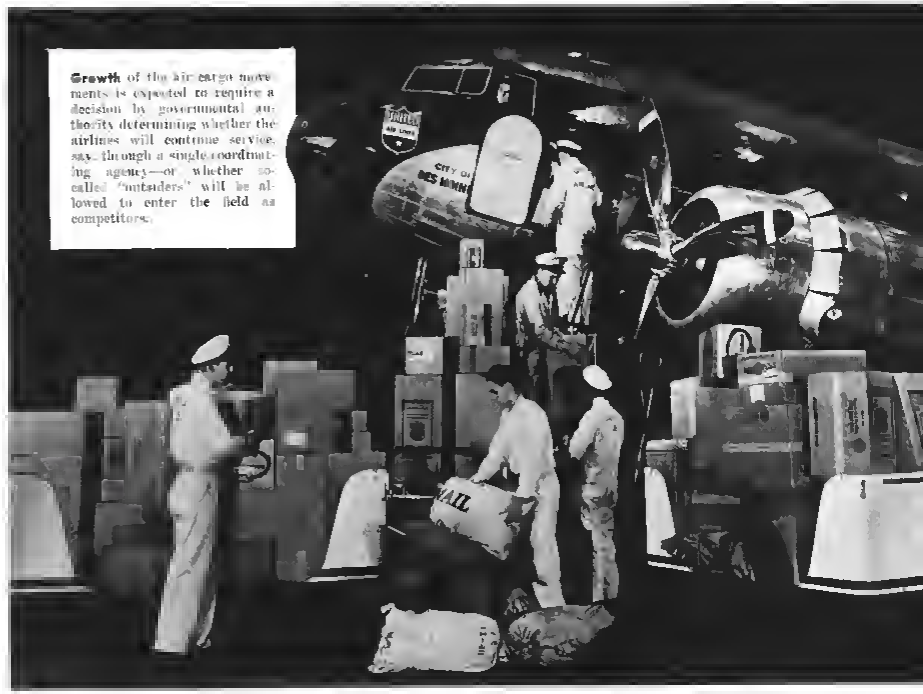
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Who Should Carry Air Cargo?

AIR TRANSPORT

By JOHN H. FREDERICK

Professor of Transportation, The University of Texas



Growth of the air cargo movements is expected to require a decision by governmental authority determining whether the airlines will continue service, say, through a single coordinating agency—or whether so-called "outsiders" will be allowed to enter the field as competitors.

This transportation authority declares for a national policy which will help airminded leadership develop commodity movement on a sound economic basis.

PRESENT EMPHASIS on movement of air cargo by the Air Transport Command and the airlines operating under Army contracts has obscured the activities of two airlines in inaugurating commercial air cargo services, open to all shippers, on flights exclusively devoted to such traffic for longer distances than heretofore. Although there has been much talk of airline cargo operations in recent years, few flights have been devoted exclusively to cargo.

In 1936, Transcontinental & Western Air attempted an all cargo service between New York and Chicago, offering midnight to dawn service, but lack of traffic caused its discontinuance Since then, with the exception of one daily New York to Chicago flight operated for a time by United Air Lines, air cargo, or air express, has always been carried on regular passenger and mail flights when space was available or by making space through "blocking off" passenger seats

For the past few months, however, Eastern Air Lines has been operating an all-cargo flight from New York to Miami with connections for South America and, on Nov 1, United Air Lines inaugurated a regular all-cargo flight between New York and Salt Lake City This is the first time an airline has operated a flight that far across the country for the sole purpose of handling air cargo From Salt Lake City, the cargo destined for the West Coast is carried on regular United Air Line passenger flights.

While this activity by at least two

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Pre cut strips of Kapok FELT being installed in the nose of a bomber

Armors planes against noise, heat, and cold

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airlines serves to emphasize the important part that air cargo is now playing in their operations, it is just the beginning of cargo transportation as it will be soon after the close of the war. This activity also emphasizes the question which sooner or later will have to be answered by the Civil Aeronautics Board—whether the movement of any cargo is to be reserved for the airlines to develop or whether other applicants for certificates of convenience and necessity to operate strictly air cargo lines will receive consideration.

This is a question of great interest to investors in airline as well as other carrier securities. Even before the advertising which the war has given air cargo, and before the shipping public began to realize its potentialities, various other groups began to show increasing interest in air cargo as a business.

Costs of plane operation have dropped materially since the days when TWA attempted to inaugurate an exclusive air express operation, and as the rates offered by the existing airlines through the Railway Express Agency have not decreased since 1934, even more "outside" groups are beginning to be interested in the possibilities for profitable all-cargo operations.

New Groups Interested

Among these so called outsiders have been the General American Transportation Corp., a subsidiary of the American Tank Car Corp of Chicago, which in 1940 made an extensive study of the possibilities for air freight development. Purpose of this study was to convince the railroads that they ought to enter the air express business, chiefly as a defensive measure so as to control possible future expansion of an air express service. Then in 1941, the American Freight Corp of California was formed for the purpose of operating an air express business paralleling the three large transcontinental routes and the north-south route operated by Braniff Airways from Chicago to Corpus Christi, Tex.

This company filed a notice of intent to make an application for these operations after it had made an extensive study of the entire air cargo picture, including ground distribution facilities, development of suitable aircraft, the most desirable routes, and the feasibility of making use of the facilities of the existing airlines. However, nothing has been heard of this development since our entry into the War.

One of the most logical developments was, however, that of the Universal Air Freight Corp of New York City, a division of the United States Freight Co., which launched a service from New York and Detroit to 14 major cities on July 10, 1941. It used existing airline facilities in an apparent effort to prove that substantial quantities of air cargo would move at lower rates than those charged by the Railway Express Agency. Although using facilities of the Air Express Division of the Railway Express Agency, Universal Air Freight offered shippers substantially reduced rates on individual packages through its ability to take advantage of lower bulk rates. For example, by consolidating a dozen or two dozen packages bound to Chicago from New York, the company obtained a lower bulk rate from Railway Express Agency and split the savings with shippers.

There was really nothing new in such a method, as it merely applied to air transportation the principles of freight forwarding long practiced by the parent company in consolidating less-than carload rail shipments into carloads. An example of savings Universal Air Freight, effected for shippers was given in the pound rate between New York and Chicago, which is $1 by Railway Express Agency and the airlines compared with 65c by Universal Air Freight, Railway Express Agency and the airlines. A limit of 15 lb. was placed on any one package acceptable by Universal Air Freight, but its consolidated packages composed of many parcels weighed considerably more, thus taking advantage of the lower bulk rates for heavy packages in the Railway Express Agency tariff. At the outset, Universal had no intention of operating its own cargo planes but did operate its own ground pick-up and delivery service through its extensive motor truck operations.

Activities of the Universal Air Freight Corp. were short-lived though, because on Sept. 15, 1942, its operations were held by the CAB to be in violation of the Civil Aeronautics Act and there came an order to "cease and desist" on the grounds that it was engaging in air transportation without having first received a certificate of public convenience and necessity. On Oct. 21, 1942 the board denied Universal's petition for a rehearing on the matter, so this type of coordinated motor and air cargo operations seems out of the picture for the time being.

Pressure from other types of carriers forced the airlines to broaden air express or air cargo operations. During 1941, UAL, AA, EAL, and TWA conducted independent surveys on the probability of air cargo traffic arising under lower rates and more varied services. These studies culminated in the formation of Air Cargo, Inc., mutually owned and controlled by them.

It was contemplated that all airlines would participate in ownership and control of Air Cargo as soon as it was found desirable for the organization to engage in actual carriage. Immediate purpose of the corporation was to make a survey to end all surveys on air cargo. Various studies were undertaken, but nothing has been made public as to the findings, and, due to the war or other reasons, Air Cargo, Inc., now seems to be inactive if not moribund.

In order to maintain its position in the air express business, Railway Express Agency applied on Oct. 19, 1938, for a certificate of public convenience and necessity as an air carrier under the "grandfather clause" of the Civil Aeronautics Act of 1938. It did not seek authority to engage in the operation of aircraft. The CAB took more than two years to pass on this application. However, on March 13, 1941, it decided that the agency could be considered an air carrier in practice but that it was not necessary for it to have a certificate of public convenience and necessity to operate as such.

By being able to find the Railway Express Agency an air carrier, the CAB brought it under the jurisdiction of the Civil Aeronautics Act. Some in the airline industry were anxious that this step be taken because it was feared that if Railway Express Agency were not subject to the act, it would come under the jurisdiction of the Interstate Commerce Commission. If this had been the case, any air cargo plans which might materialize in the future might also be regulated by the ICC, and the entire control of air express and other cargo might thus be taken out of the CAB's hands.

Decision Still Pending

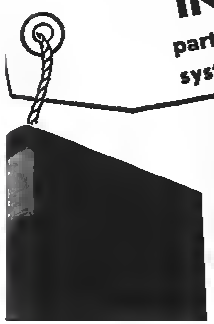
Investigation by the Board of the air express contracts between Railway Express Agency and the airlines is still in progress, but it may be that after this investigation is finally completed the agency will be forced to apply for a certificate of convenience and necessity, not under the "grandfather clause" as it did before but for what might be termed a "new route." This application will be heard by the Board, and Railway Express Agency will have to prove public convenience and necessity for its services, after which a certificate may or may not be issued. If issued, it is almost certain to contain terms and conditions making it impossible for the agency to operate its own planes, thus settling a point which has bothered the airlines for some time.

As a result of the March, 1941, de-

(*Turn to page 344*)

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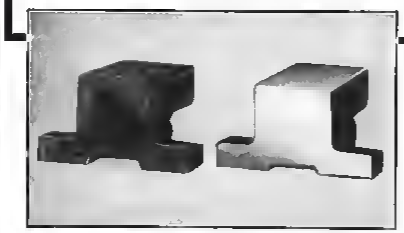
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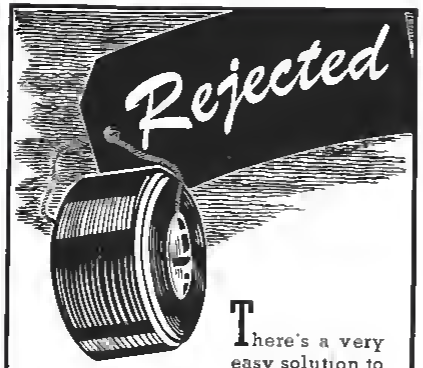
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Fighting Snow

(Continued from page 99)

snow to one side, usually the right of the truck. Such blades are good up to several inches of snow for a single pass such as is required to clear one side of a highway or opening swaths on an airport. When several such passes are made, as is necessary in clearing a wide runway, the snow builds up and the width of the cut must be reduced. Blades are designed to be most effective at certain speeds, and as the snow piles up the speed possible with the unit is cut below that necessary to impart a rolling motion and it bogs down to just bulldozing the snow.

A heavier propelling unit is then mounted with a one way or a V-plow designed to roll the snow at a lower speed. The V-plows are generally symmetrical about the centerline and are intended for making a first cut opening of a drifted road. Offset V-plows, designed for widening roadway cuts and for airport use, are now available. They have blades 6 to 8 ft. long on the right-hand side of the truck and only 3 or 4 ft. long on the left side to permit the unit to be used for cutting through a completely drifted area with more effectiveness than a one-way plow and yet be efficient for plowing on only one side. The center is mounted somewhat to one side of the truck centerline to distribute to the thrust evenly on the truck.

Various combinations of one-way plows, V-plows, and either one or two wings for pushing the snow farther out or for shaping the banks are available. The wings are usually about 2 ft. high and are so designed that they can be raised and held at any height or angle desired or lowered to the pavement and used to widen the swath that can be cleared by a single passage of the plow.

The rotary or blower unit, very desirable for spreading out the snow well back from the runways, generally has some means of breaking down hanked snow and feeding it into rapidly rotating fans that throw the snow to one side with considerable velocity. In most machines the power for the snow blowing unit is supplied by a separate motor, usually located back of the cab to give better weight distribution and traction to the truck unit. Power is transmitted to the blower unit through universal joints and flexible drive devices, though this is avoided in some makes by mounting the engine on the same carriage with the plow, which pushed ahead of the truck. Some machines combine the features of the plow and rotary unit by use of a one-way blade feeding to a single rotary blower or by a V-plow, or a double

(Turn to page 132)



QUICK HELPS ON SNOW REMOVAL

Get and keep your own snow removal equipment. If you depend on highway or municipal machines chances are you won't have equipment when you need it. Keep the snow off the runways. It has to come off some time, so keep it off currently.

Have your equipment overhauled and ready-to-go well in advance of expected snow season.

Turn the contact lights on day or night when snow starts. Their heat will prevent snow from covering and obscuring the lights.

Keep 150 ft. width of runway open and slope snow banks 3 ft. in 100 ft. for first class airports.

Rolling the snow outside the cleared area will help to prevent drifting.

Where plows are used alone, be sure to open a sufficient width on the first plowing to permit piling subsequent snow inside the banks.

If two speeds are available on rotary blowers, use the slow speed on wet snow and high speed on dry snow.

Be sure that lights on the snow handling machines are high enough to clear the plows.

Have chains ready for all wheels of trucks or rubber-tired tractor units but don't use them until wheels begin to spin or side thrust develops.

Paint a contrasting stripe down the center of runways to guide pilots landing on low visibility nights when the edges of runways may not be well defined.

Keep motive equipment in heated garages for care-free starting and maintenance.

Paint machines to be used on the field a bright yellow or orange for daytime visibility. White or dark colors do not give sufficient contrast. Blinker lights are desirable at night.

Cutting blades will be hard to get this year for all types of snow moving machines. Old blades can be built up and new ones given much longer life by welding a ½ in. die bead of nickel steel rod the full length of the blade and adding two successive beads of abrasive rod.

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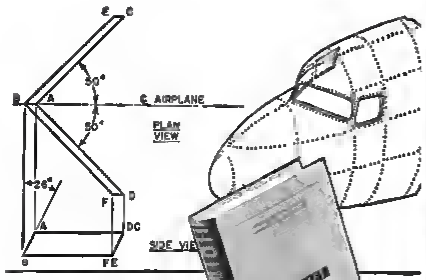
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Official Photo Courtesy U.S. Army Air Forces

Visual Aids Speed Mechanic's Training

By LYNE S. METCALFE

Casey Jones School of Aeronautics correlates slidefilms with tests and demonstrations to impart basic skills and specialization.

MAKING AN AVIATION MECHANIC of an untrained and inexperienced youth presents many training problems as complex as those encountered in training pilots. The mechanic must, in addition to his basic skill, also be something of a specialist—and today he must be given both these basic and specialized skills in a minimum of time.

While aircraft and engine maintenance and repair bring into play many of the basic skills which serve in peacetimes, the demands of war have brought to the aviation schools of the country thousands of young men who are not at all familiar with aeronautical mechanics.

Early in the vast air expansion program this situation forcibly brought up the question: How can the elementary factors be taught most rapidly so as to give time for concentration on the more detailed and practical application of theoretical knowledge?

The skilled lecturer, the text-book, the physical demonstration, plus actual shop and workbench practice must, of course, remain the basic mediums for vocational instruction in the field of aviation, just as in others. But the primary need to show the "green" recruit "what it is all about,"—and in the shortest possible time—was the problem. If this preliminary "getting the feel of it" interlude could be reduced, much could be done to speed the process of turning out finished aviation mechanics.

As one means, the industry turned to the picture screen, selecting the discussional type of slidefilm or filmstrip. The discussional, or reading, slidefilm is a strip of 35-mm. safety motion picture film with explanatory text, labels, letterings, legends, or notations superimposed on the film. Specific purpose of this form of film is to permit the instructor to read or speak and to permit the students to talk if desired. Such films, which can be used in any ordinary slidefilm projector, supply illustrated material in illuminated form for class participation and encourage discussion.



Slidefilms, which can be used with any ordinary projector, have been found valuable time-savers in imparting basic skills to the growing army of aircraft and engine mechanics necessary to maintain the country's swiftly growing air forces. Such visual aids are extensively used as an integral part of training programs involving texts, lectures, and actual practice such as shown, above. Below: Slidefilms kit.

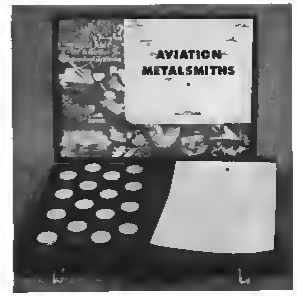
Slidefilms now widely used in training aviation mechanics are available in sets such as the following.

Aircraft Mechanics Training Kit: Consists of 41 separate slidefilm subjects, totalling 1,078 individual pictures, drawings, photos, diagrams, sketches, and exhibits.

Aircraft Engine Mechanics' Kits: Includes 22 separate slidefilm subjects, comprising 1,316 individual pictures.

Aviation Metal-smiths Kit: Nina

(*Turn to page 347*)







Mass Mechanical Radio Instructor—Automatic radio code machines in operation at the Enid, Okla., Army Flying School can "send" messages to as many as 220 students at the same time. The six different machines can be set to send different messages to separate groups of students at varying speeds. The code is imprinted on a tape by a printing stylus in much the same manner as a barograph recorder. In operation the tape passes over a photo electric cell energizing a mechanical sender

Along the Apron

• United Air Lines' pilot-training school has been moved from Cheyenne to Denver, Walter J. Addems, director of flight operations, announced . . . Braniff Airways is training Army Air Force pilots, giving a three months' course in ground training, instrument instruction and transition to large bi-motored craft. On completion of the transition work the students will be assigned to Braniff cargo operations, later being assigned as co-pilots on these runs . . . Engineering training courses being conducted jointly by Consolidated Aircraft and the University of California on a full-time pre-factory basis are attracting more and more women. Enrollments for the 480 hr. course in aircraft drafting and elementary stress analysis have reached 85 percent women, with one class composed entirely of women. A complete school, equipped to care for 3,000 students, has been opened by the sponsors . . . Polaris Flight Academy late last month graduated its concluding class of RAF cadets and is now devoted entirely to training cadets for the American Air Forces . . . "The Evans Grant for Air Cargo Research," founded by Col. E. S. Evans, has been established at Wayne University, Detroit. Col. Evans said the purpose in establishing the program is "to determine as nearly as possible the exact cargo that will be feasible for transportation by air." Research will be under the direction of Dr Spencer A. Larsen, Associate Professor of Marketing in the School of Business Administration, and Allen Dean, Transportation Expert, Detroit Board of Commerce, will serve as Traffic Consultant.

Snow Landing Warning

Civil Air Patrol pilots working on courier service which requires their flying into strange fields are cautioned to first remove wheel pants to guard against mud and slush freezing and locking the wheels. On some dull, hazy days in winter, the engineering department of Aero Insurance Underwriters also points out, depth perception on snow is very similar to glassy water. Many airport managers mark runways with coal dust or ashes to help visibility but, the department notes, if there is nothing to serve as a guide, it is best to bring the ship in a little faster under power to prevent stalling. On the other hand, if visibility is good on a field covered with loose snow, it is advisable to try to land tail first, holding back hard on the stick and applying power on contact with the snow to keep from nosing over.

"If the snow is very deep there isn't much you can do but try and save the propeller by cutting the switch and go over as slowly as possible," the bulletin warns, adding that "the best way is to stay away from these conditions."

On Patrol

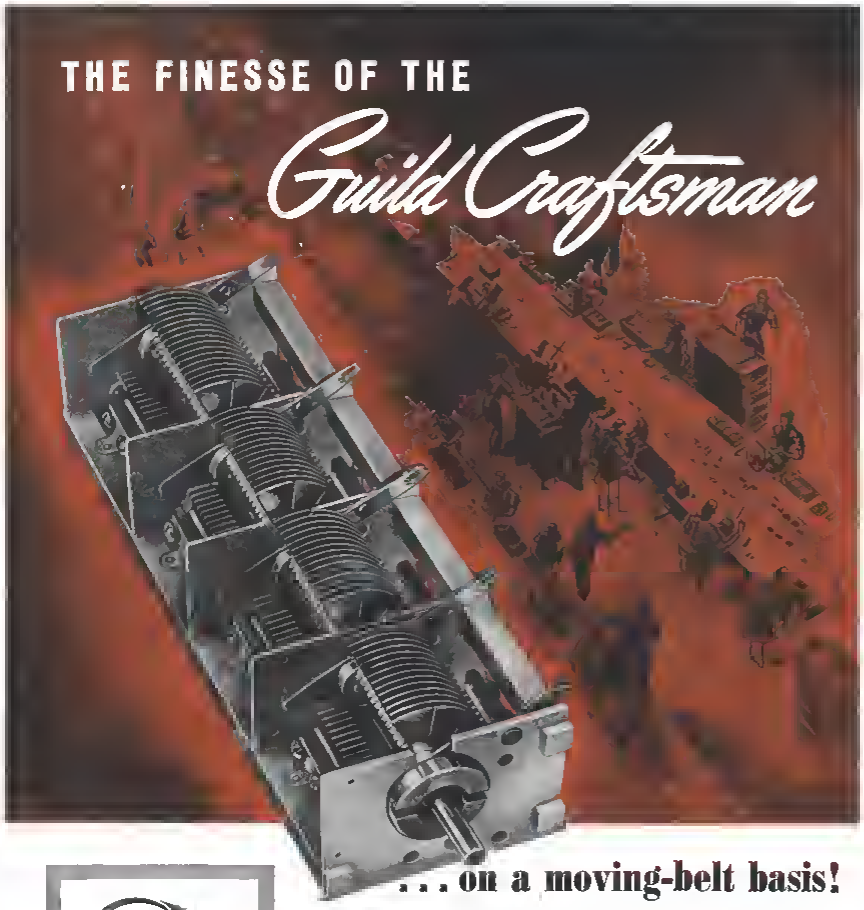
• Expansion of CAP Courier Service continues. In the West, for example, what started as a 30-day experiment has built up to real airline operation, with daily schedules being maintained in at least five states and with surveys under way in several others. Much of this expansion has been due to cooperation of Maj. Gen. Robert H. Olds, Second Air Force Commander . . . The Reading, Pa., Courier Station recently flew in a small lot of parts whose lack was holding up a war plant production line . . . In the Chicago area CAP planes have flown key men into other states on rush jobs on which much valuable time would have been lost through other means of travel . . . CAP pilots and planes are still "getting in the scrap"—a pilot and observer from the Tulsa, Okla., group found between five and six carloads in an abandoned oil field. the Northfield, Ohio, Squadron was responsible for locating some 250,000 lb by aerial survey, and the Pensacola, Fla., Squadron located a steel bridge on an abandoned logging road . . . With many units completing their basic training courses. Headquarters is working on additional courses on care, use and rigging of parachute rigging; care and use of firearms and photography.



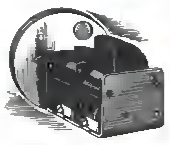
Low-level Bombsight—Norman Greene, of Berwyn, Pa., demonstrates the inexpensive low level bombsight which he developed for use with light planes such as those employed by Civil Air Patrol Squadrons. Greene's bombsight, which he designed and built in his own workshop, is made of scrap metal with a calibrated Plexiglas dial and employs a pendulum to keep the sight at right angle to the ground.

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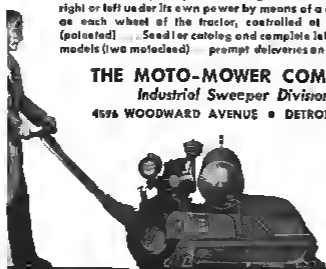
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Accuracy of the flashing characteristics of the W&T flasher mechanism is held constant by a governor-controlled motor. The unit requires a very small amount of energy for operation, and is capable of performing for long periods of time without appreciable wear of the moving parts. It creates no objectionable radio interference, is temperature compensated, and has successfully met all C.A.A. requirements, including those for vibration.

Having a capacity for handling three 32 candlepower lamps on each circuit, all initial installations can flash the wing tip and two added white fuselage lights should regulations ultimately require the flashing of all navigation lights. For complete information write for Technical Publication 234.



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The AVIATION NEWS

BLAINE STUBBLEFIELD, Washington C. B. F. MACAULEY, New York E. EUGENE MILLER, New York JOHN FOSTER, JR., New York

Arnold Pictures New Air Weapons, Bigger Bombers About to Blast Axis

That the Air Force has some new air weapons on the assembly lines that will soon "deal paralyzing blows to our enemies," was revealed by Chief of Air Force Lt. Gen. Henry H. "Hap" Arnold, in a recent address to graduates of Randolph and other Texas flight schools.

Stating that we have our bombers and fighters working in eight combat zones, Gen. Arnold continued: "Within a few months the Germans and the Italians will be feeling the impact of hundreds of planes dropping their bombs not on one or two nights a week but every day and night of the week." His statement that the B-17 and B-24 are now regarded as "small bombers" may mean that the B-29 and other new larger craft are now in production.

Ratio of planes lost is about 4 to 1 in our favor in the first ten months of 1942. Gen. Arnold said the Air Forces have destroyed 928 enemy planes and probably downed 276 more in aerial combat, while our loss was 130, with 104 missing.

Standard .50 calibre machine guns are "terrific weapons of aerial destruction," Arnold asserted, but they will seem "like peashooters compared with the firepower that we are putting into our newest big ships." Further, he told of new cameras that can see a railroad tie from 30 000 ft. while hurtling in a plane at 300 mph.

Record in 1 063 different sorties, up to Nov. 30, against the Germans is a loss of 32 planes by aircraft and anti-aircraft fire. During these sorties, 293 enemy planes were definitely destroyed, another 150 were probably destroyed, and 162 were damaged.

In the Southwest Pacific, the long range bomber can execute missions from bases so far removed from Japanese forces that no attacks can be made upon our bases by the Japanese except from aircraft carriers.

Declaring that both the German and Japanese Air Forces are on the down grade (as did Churchill recently) Gen. Arnold said that in one year after Pearl Harbor the Air Forces have a million officers and men and will have over 2 000 000 by the end of 1943. "We are just approaching our peak in airplane production and combat crew training. United States plane production alone is more than that of the Germans and Japanese combined."

Destruction by air attack of enemy ships stands 51 sunk, 21 believed sunk and 159 damaged. These ships were of all types from battleships to destroyers, tankers, cargo, and troop carriers.

Alaska Lines Under CAA; Irregular Run Gets Okay

In an order to bring Alaskan air transportation under the economic provisions of the Civil Aeronautics Act, the CAB announces it has granted 22 certificates to 21 Alaskan air carriers while denying 2 applications and dismissing 13 others.

The board also announced it had issued two certificates to PAA, authorizing service between Fairbanks and Nome, Alaska, for persons, property and mail, and between Fairbanks and Bethel, Alaska, for persons and property. These routes supplement PAA's Seattle-Juneau, Fairbanks-Whitehorse and Juneau-Whitehorse services.

In granting the Alaskan certificates the board authorized an "irregular" route service in which areas of operation are defined but in which scheduled services by the irregular route carrier are not permitted if they conflict with the "regular" route of another carrier.

Seven CAA Changes

CAA changes are announced by Administrator Charles I. Stanton. John E. Sommers, former Maine-to-Virginia regional manager at New York City, becomes Deputy Administrator succeeding A. S. Koch called to active duty with the AAF.

Other replacements because of service calls now find Fred Lanter as director of Safety Regulation, E. R. Scroggie as chief of the General Inspection Div., H. A. Hook regional manager at Santa Monica for California, Nevada, Arizona, and Utah; William E. Kline, manager at Kansas City for Kansas, Missouri, Nebraska, Iowa, South Dakota, Wyoming, and Colorado; William Robertson, manager at Atlanta for Georgia, the Carolinas, Tennessee, Alabama, Florida, Mississippi and Eastern Louisiana, and Paul Morris, manager at Seattle for Washington, Oregon, Idaho, and Montana.

NATS Serves 20 Bases

It is revealed that the daily personnel-and-supply flying routine of our Naval Air Transport Service now links more than 20 naval bases within the continental limits of the United States, the Caribbean, the Canal Zone, Newfoundland and Alaska. Planes used: Martin PBM-3's, Douglas DC-3's, Consolidated PBY's, and PB2Y's.

New Continental Route

CAB has granted Continental Airlines permission to operate a new route between Denver and Kansas City via Salina and Topeka, Kan., when "national defense no longer requires a delay in inauguration of service." Certification that such time has arrived will signal the opening of the new service.

Doolittle Promoted Again

New promotion by Pres. Roosevelt has raised Brig. Gen. James H. Doolittle, chief of the 12th Army Air Force in North Africa, to the rank of Major General.



NON-METAL "CARAVAN" NEARLY READY FOR RUNWAY

Photoed for the first time, America's initial basically all wood military transport, the giant Curtiss C-76 "Caravan" offers impressive promise of troop and cargo carrying efficiency as it gets finishing touches in Curtiss-Wright Missouri plant. "Freighting bulk" of this plane which will serve widely scattered war fronts is evidenced by comparison with AT-9 job nestled under left wing. Two 1,200 hp. engines are mounted by the 108 ft. span, 68 ft. high "Caravan" which is second transport put into production in 1942 by C-W, other being all-metal C-46 "Commando." According to Burdette S. Wright company vice president, "Caravan" accommodates crew of pilot and co-pilot, also provides for radioman when desired. Featured, he states are low landing speed and low stalling speed for effective task operations, cargo floor but 36 in. from ground to facilitate loading and ease of field maintenance because of simplified structure. Almost entirely of wood, craft combines molded plywood, laminates, and plain lumber including hickory, spruce, birch, gum, mahogany, and Douglas fir. While first of these C-76's are being made in Missouri, quantity production will follow in newly erected Kentucky plant, with Mengel Co. of Kentucky, Baldwin Piano Co. of Ohio, and Universal Moulded Products Co. of Virginia as major subcontractors.

Vultee To Take Over Mack Truck Plant; Will Build Torpedo Bombers

Washington (AVIATION Bureau)—Vultee Aircraft Inc., is taking over a large Pennsylvania truck plant formerly operated by Mack Truck Corp., to start work on a contract totaling more than $100 000 000 worth of torpedo bombers of undisclosed design for the Navy, according to a joint announcement by Charles E. Wilson, WPB vice-chairman, and Tom Girdler, chairman.

New construction and equipment will cost $11,000,000, with much of the equipment to be supplied by Defense Plant Corp. Construction will include an office building, hangar, and airport with two 4,000-ft runways.

Employment will total several thousand in the plant itself—of which approximately half will be women—and about 50 percent of the total volume of work will be subcontracted to eastern and middle western suppliers.

Archibald M. Hall, recently manager of Consolidated's southwest division, has been named acting manager of the new operation. Other appointments announced by Mr. Girdler include: Warner Jones, assistant manager; H. S. Delchert, factory manager; Ross Laughlin, material control supervisor; David Herman, plant engineer; C. F. Pape, contract administrator; J. O. Cornete, division controller; and William Dieter, chief engineer.

Wright Succeeds Talbott

T. P. Wright, Jr., is now director of the WPB's Aircraft Production Div. following the resignation from that post of Harold E. Talbott. Mr. Wright was formerly deputy director. This change is interrelated with the current development of the "Little WPB" for the aircraft industry, which is under the chairmanship of Charles E. Wilson. (See news story on page 281, also December AVIATION, page 277.)

"Merlin" G1 Engine Details Revealed

London (Special cable to AVIATION)—Details just revealed by the British Ministry of Aircraft Production show that the new Rolls Royce *Merlin* 61 engine gives the new *Spitfire* which it powers considerably increased performance with little additional weight and a minimum of design changes in the airframe.

One of the outstanding features is the 2-stage supercharger which is, in effect, two superchargers in series. The two supercharger rotors are located on a common shaft, driven by the standard Rolls Royce 2-speed rotor gearing. Fuel mixture is drawn from the carburetor and compressed by the first stage supercharger, then delivered to the second stage and finally to the induction manifold, the charge being delivered at 8 lb. atmospheric pressure at 40 000 ft.

The supercharger system is fitted with a box structure, liquid-cooled intercooler located in the induction system, the fuel charge being passed through the matrix of the intercooler and its temperature reduced to normal. A separate water jacket, located between the first and second supercharge stages, also helps reduce the temperature of the fuel charge. Intercooler and jacket are independent of the engine coolant system, the intercooler being mounted under the wing in a duct which also houses one main engine radiator.

While the power of the new engine is not given, it is understood to show a sizable increase over the *Merlin* 20, which develops 1 260 hp at 12,250 ft.

A twelve-cylinder Vee engine, the new 61 weighs 1 640 lb., has a bore of 5.4 in., stroke of 6 in., and displacement of 1,647 cu. in.

Its installation in the new *Spitfire* makes the plane slightly longer than previous models. There is a slightly different shape of wing and a four-bladed, full feathering propeller is employed. However, the new *Spitfire* greatly resembles predecessor models in appearance except for dual radiators—made necessary by the supercharging system—fitted one under each wing.

Armament consists of two cannon and four machine guns.

Josh Lee Named for CAB, Ryan Re-Nominated

Washington (AVIATION Bureau)—Nomination by the President of Josh Lee, defeated senator from Oklahoma, to serve the remaining year of the unexpired term of Dr. George Baker as vice-chairman of the CAB, is announced. And as this is written, confirmation of Mr. Lee, who is known to be aggressive and who has had some experience in aviation committee work, awaits the convening of the new Congress.

Meanwhile, the President has re-nominated Oswald Ryan for another six years. Mr. Ryan has been the board's acting vice-chairman. Designations of the CAB's chairman and vice-chairman for another year are expected soon from the President. Currently, Welch Pogue is chairman. The post for which Josh Lee has been named was relinquished some months ago by Dr. Baker, who left to become chief of the Requirements Branch, Military Planning Div., Quartermaster's Office.



Official U. S. photo

REAR ADM. G. O. MURRAY

Commend of the Navy Air Training Center at Pensacola has now been assumed by Rear Adm. George O. Murray. One of the Navy's earliest pilots, Adm. Murray commanded an aircraft carrier in the Marshall Gilbert raids. The change also makes him chief of the Air Immediate Training Command at the Pensacola Air Station.



NEWEST "SPITFIRE"

Latest version of Supermarine "Spitfire," backbone of RAF's fighter force, is armed with two cannon and four machine guns. It is said to be particularly effective at altitudes up to 40,000 ft., credit going to Rolls Royce Merlin 61 engine, details of which are revealed in accompanying news.



Wide World photo

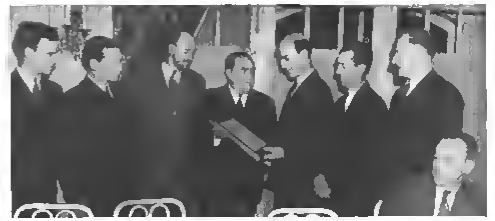
"ARGUS" ON PATROL—"SEAFIRES" UP

Britain's flush-deck carrier 'Argus,' which was in forefront of Allied invasion of North Africa, plows through combat waters off African coast. Two planes seen in photo—one at bow, other "shooting deck," flaps down, at starn—are 'Seafires' Model is carrier version of celebrated 'Spitfire.'

Employees Give Naegers

Marking Pearl Harbor day, employees of the Ranger Aircraft Engines Div., Fairchild Engine & Airplane Corp., presented two 6-cyl. engines to the AAF and one 12-cyl. engine to the Navy. The powerplants were purchased with employee-contributed funds. Representing the Services were Under Secretary of the Navy for Air Artemus L. Gates and Brig. Gen. A. W. Vanaman, Commanding AAF Material Div., Wright Field. The ceremonies also served to dedicate completion of new facilities more than doubling the plant's manufacturing area.





AIRLINES GET AVIATION'S MAINTENANCE AWARDS

Presentation of AVIATION'S Maintenance Award plaques for 1942 was made as the year ended, to Continental Air Lines and American Airlines at a dinner sponsored by Air Transport Association in Chicago. Left: Leslie E. Neville, editor of 'Aviation,' awards plaque to Stanley R. Shetta, Continental's vice-president in charge of engineering and maintenance. Right: F. J. Martin, American's superintendent of maintenance, receives award as colleagues look on. Standing (l. to r.): Dixon Speas, M. O. Miller, Chief Engineer Otto Kirchner, Mr. Neville, Mr. Martin, Snyder, Overhaul Ray Miller, and Vice-President Engineering William Littlewood. Seated: W. C. Mentzer, chief engineer of United Air Lines, who acted as toastmaster. He cautioned winners not to rest on their laurels because other airlines are "hard out" to win the Maintenance Awards in the 1943 competition, now underway.

Open New Lincoln Contest; List Recent Weld Awards

New award program for engineering students is announced by the James F. Lincoln Arc Welding Foundation of Cleveland. Titled the $8 750 Annual Engineering Undergraduate Award and Scholarship Program, this latest project, to extend until April 1, is "to encourage engineering students to study arc welded construction so that their imagination, ability and vision may be given opportunity to extend knowledge of this method and thus aid the war effort and the economic reconstruction in the peace which is to follow."

Awards will be made for papers describing conversion to arc welded construction, based on subject matter personally encountered, read, or conceived by the student. Aircraft engines, fuselages, and their accessories are listed among typical fields.

Any resident engineering undergraduate student registered in any United States school or college giving a course in engineering or architecture leading to a degree, or any cadet registered in the United States Military Academy, Naval Academy or Coast Guard Academy is eligible. Emphasis being on design, participants do not need to be enrolled in any welding course, nor is any previous welding training required. Necessary background can be obtained with a little reading. Further details are available from the James F. Lincoln Arc Welding Foundation, P. O. Box 5728, Cleveland.

Aviation men figured prominently as winners in the Foundation's recently closed scientific award program. Chiefly honored, their awards and subjects:

Vladimir H. Pavlecka and John K. Northrop, chief of research, and president, respectively, Northrop Aircraft, Calif., $3 700. Subject: Arc welding magnesium alloys. H. A. Lebert and S. B. Willoughby, inspector and arc welder, respectively, United Air Lines Transport Corp., Wyo., $2,500. Subject: Boiler for airplane heating system. Peter F. Rossmann, chief of miscellaneous developments research, Curtiss - Wright Corp., N. Y., $1 500. Subject: Comparative study of torch and arc welding under shop conditions. W. S. Evans, materials and process engineer, Curtiss-Wright Corp., Missouri, $1 250. Subject: Procedure in determination of arc welding fabrication.

Among other winning subjects: Fabrication and truss-and-column erection of a 131x244-ft. hanger. Van Rensselaer P. Saxe, Md., Arc welded tubular aircraft jigs. R. H. Holmes, Calif.: Propeller blade for aircraft. Dr. E. K. Benedek, General Hydraulic Co., Ohio; Design of jigs and fixtures. H. V. Wenger, Boeing Aircraft Co., Wash.; Redesigning of airplane engine tail pipe. M. Buiger, welding foreman, American Airlines, N. Y., Arc welding aircraft refueling tanks. H. C. Frentzel and A. Meyer, Heil Co., Wis., Arc welding stainless steel in making aircraft exhaust manifolds. C. Pettit, Harvey Machine Co., Calif.

Stout to Consolidated

William B. Stout and his entire Stout Engineering Laboratories organization has been engaged full-time by Consolidated Aircraft Corp., announces Tom M. Girdler, board chairman of the latter firm. In the future the engineering organization will be known as the Stout Research Division of Consolidated.

PAA Gets Safety Award

The Arthur Williams Memorial Award has been presented to Pan American Airways by the American Museum of Safety. The gold medal and accompanying plaque read: "For pioneer service insuring utmost safety in overseas flight."

Chairman Welch Pogue, CAA, made the presentation, which was accepted by J. T. Trippe, president of Pan American, "on behalf of the company's 23 000 employees."

Tracing the history of overocean flight, Mr. Trippe said that in the past three and a half years his company's Clippers have completed 1,156 transatlantic crossings, flown 6,600,000 miles, and carried 44 000 passengers and 2,400 000 pounds of cargo without accident.

Engine Orders to Aircooled

Additional orders for unrevealed quantities of Franklin aircooled aircraft engines have been placed with the Aircooled Motors Corp., Syracuse N. Y., by both the AAF and the Navy Bureau of Aeronautics. The engines said to be of the horizontally opposed type, have been developed by Aircooled Motors engineers working closely with the AAF and the NBA. states C. F. B. Roth, general sales manager. Extensive tests having been conducted over a period of months, immediate quantity production is scheduled.

Eastern Aircraft Begins Deliveries

Delivery of Grumman *Wildcat* fighters and *Avenger* torpedo planes to the Navy has been started by Eastern Aircraft Division of General Motors eleven months after beginning the conversion of five former automobile assembly and manufacturing units which made GM the first organization in the automotive industry to convert plants to complete aircraft production.

The Navy designation for the Eastern Aircraft-built *Wildcat* is FM-1 and for the *Avenger* it is TBM-1. The planes are built to Grumman F4F and TBF designs, respectively.

Higgins Cargo Craft Order Put at $200,000,000

Word comes that the 1,200 plywood cargo planes to be built for the War Department by Andrew J. Higgins, maker of Navy combat boats will cost some $200 000 000 and will be constructed in a new $23,000,000 plant on the site of the unfinished Maritime Commission-Higgins shipyard, which will be leased to the Higgins Aircraft Co. by the Defense Plant Corp. for $1 a year.

To make the yard available to Higgins, the Commission transferred it to the War Department which in turn retransferred it to the Defense Plant Corp.

Delivery of the first planes, which are to follow the basic design of the Curtiss-Wright C-76, is planned within six months. Construction of the necessary engines is also planned by the Higgins firm. But since it is doubtful that these powerplants will be ready for the initial craft, the Army will supply the first batch of engines.

New Fairchild Cargo Craft

Fairchild has designed a new long-range military cargo plane for carrying guns, tanks, ammunition, supplies, troops or paratroops to distant points of combat and operation. Designed to operate into and out of fields of limited size, the craft's maximum range is put at 3 500-plus miles.

How Consolidated Aircraft GETS 61% MORE LIGHT...

RIGHT HERE

...AND 20% MORE LIGHT



HERE



Light-Reflecting Floors Help Speed Production and Increase Efficiency on Assembly Lines

THESE two pictures tell the story. The riveter is getting maximum light on the under side of an aircraft wing on the Consolidated Aircraft Corporation production line at Ft. Worth. His work is faster . . . surer, because he can see more clearly. He's standing on *a white concrete floor* made with Atlas White Cement. And this floor, according to light measurement tests by General Electric lighting engineers, reflects 61% more light on these underside surfaces than do the gray concrete floors in the same plant.

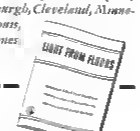
In addition, the tests in this plant show that the white cement floor also produces 20% more illumination on vertical work surfaces than does the gray cement floor. Given these two increases in light, you can easily imagine the satisfactory effect on work efficiency and plane production.

Get all the facts. Write for LIGHT FROM FLOORS—a new, 24-page manual on lighting checked by leaders in the lighting field. It contains photographs of installations, charts, studies of the results of light-measurement tests, chapters on the importance of better lighting in industry, and recommended practice for laying white concrete floors. Here's a book that will show you how floors can be made to help reduce spoilage and increase production. Mail the coupon today. Universal Atlas Cement Company (United States Steel Corporation Subsidiary), Chrysler Building, N. Y.

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ATLAS WHITE CEMENT

FOR LIGHT-REFLECTING FLOORS



Universal Atlas Cement Company
Chrysler Building,
New York, N. Y.

Please send me copy of new book, "Light from Floors" AV-F-6

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Flexible Jigs, Tools Speed Production

The aircraft industry has developed a new technique to maintain warplane production up to schedule while making constant alterations. Manufacturers have developed flexible multipurpose equipment which reduces production to subassemblies and even subsubassemblies so that as design changes are ordered, the machinery and facilities can be adjusted to the new specifications while changes are made on each ship.

The companies have had to invent tools to serve several purposes.

Zinc is replacing steel dies used to stamp out parts. Zinc doesn't last as long as the steel but the dies of zinc can be designed and cast in two weeks compared with two to six months for steel. Much of the hand work where parts are cut or stamped from metal patterns or templates has been swung to machines.

Congress Votes Funds for 500,000 Tons of Carriers

Included in the newest supplemental war appropriation is authorization for the Navy to contract for 500,000 additional tons of aircraft carriers at a cost of $9,510,000,000. This tonnage has been authorized in laws passed last July.

Assistant Secretary of Navy James V. Forestal said the new carrier program would involve a change of emphasis upon other materials, because capacities for producing machine tools, reduction gears and propulsion machinery for the carrier program will have to be taken away from something else.

The war in the Pacific has pivoted upon carriers from the beginning. This new carrier program is part and parcel of the Navy's new combat plane expansion project although it is under the Bureau of Ships.

Discussion of carrier plans was secret but it was made known that the new ships will be large. Some recent reports have indicated they should be small, to avoid having so many eggs in one basket.

Adm. John Towers explained that though big carriers make a big target, still they can carry more protection, and take more punishment.

The Japanese had ten or twelve carriers at the beginning of the war, but have lost over half of them, and are frantically building more, meanwhile converting passenger and cargo ships to "flat tops."

Library Has Aero Division

Establishment of an aeronautics division in the Denver public library is announced by Librarian Malcolm G. Wyer, who has long been an NAA member. Basic in the library's collection are the hundreds of rare Maggs volumes on early aviation obtained by Dr. Wyer from London just prior to the heavy raids.

William E. Barrett has been named as the division's consultant. Author of numerous aviation articles and writer of aero book reviews for the *Boston Post*, he is an honorary member of the 50th Squadron Association.

Launch New Carrier

The aircraft carrier *Belleau Wood*, named to honor the famed American battleground in France in World War I, was recently launched at the yards of the New York Shipbuilding Co. It was the third carrier launched at the yard in 15 weeks.



International News photo

TRIO OF SKY TITANS

Striking mid air lineup of AAF's "big three"—all four-engine quantity-production jobs. Left to right are Boeing B-17 "Flying Fortress" bomber, Douglas C-54 "Skymaster" combat transport, and Douglas B-24 "Liberator" bomber. Long rangers every one!

The Washington Windsock



By BLAINE STUBBLEFIELD

Mail rate cuts by the CAB imply a long and many-sided controversy. Eastern Air Lines and American Airlines are set back to .3 mills per lb. mi. Obvious reason is that they made money. And these operators believe they made it by efficient management. If so, they are now penalized for efficiency. But the government is thinking of the millions who use air mail. The Post Office wants the rate still lower, and it is looking toward delivery of *all* first class mail over night. Whereas the airlines have had a "subsidy" in mail pay to enable them to operate, it now appears they may some day be required to carry the mail as a fee for their franchise.

It finally happened. A certain CAB examiner heard the evidence in an application of All-American Aviation for a new stop somewhere, and he said: 'Due to the simplicity of this case I hereby recommend approval."

Foremost tourist attraction in America will be the Wright brothers' original airplane, which will be brought back from England. Nobody knows who first covered ground on wheels or navigated water, which were great events. But we *have* got the main souvenir for heavier-than-air pioneering.

The Era of wonderful nonsense is here again. People are selling (in speeches) millions of private and cargo planes—putting automobiles and railroads and the merchant marine all out of business at one swoop. Don't borrow or lend on that. The next 20 years will be like the last 20—hard going, step by step.

These Russians have a supercharger, too. Inside the fuselage of one of their bombers, they've fitted a 1,000-hp. engine and blower unit which furnishes compressed air to the four engines, perhaps to the cabin also.

Word comes to Washington that both the armed services and the manufacturers are having increasing trouble keeping radio, armor, gun and oxygen specialists from leading up every design with their particular pets.

Pressure cabins, long in development, at last appear on the fighting fronts. First one reported was incorporated in a jazzed-up *Spitfire* in North Africa, operating far above the 40,000-ft. level. But the engineers look upon super-charging of combat-crew compartments as a very hard problem, and they will not promise that it will go very far in this war.

How can you tell, when experts themselves disagree by 1,000 percent? One airline authority now estimates that the ton-mile cargo rate might be pulled down from the present 40c to 10c. Plane manufacturing authorities say they can fly commodities in competition with steamships whose ton-mile rates are a fraction of 1c. We want to pose as an expert ourself long enough to advise you to wait a few years and see.

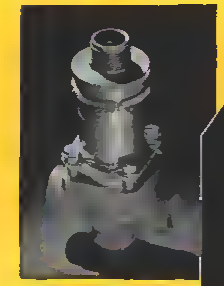
Instruments Controlled

Strict control was placed over small panel electrical combat measuring instruments by Limitation Order No. L-203 announced recently by the Director General for Operations.

The order provides that no manufacturer shall accept any purchase order for combat measuring instruments unless it is an approved purchase order. Such an order is one that is placed by the Army, Navy, Maritime Commission or War Shipping Administration, or one for aircraft, or any other order approved by the Director General for Operations.

Monthly delivery schedules must also be filed by suppliers of combat measuring instruments. This requirement will enable the War Production Board to equalize the production of instruments throughout the industry.

NO CONCESSIONS TO WEIGHT *HERE*



General Controls Type AV-1

8½ OUNCES

GENERAL CONTROLS hi-g
OIL DILUTION, CABIN HEATING,
HYDRAULIC & ANTI-ICING VALVES

HIGHEST "g" FACTORS—LOWEST WEIGHT

Most important operating characteristic of all General Controls Aircraft Type Electric Valves is their positive ability to operate in any position, regardless of vibration, change of motion or acceleration, i.e., substantial increases in "g". This is accomplished without any concession to weight, for although acceleration factors as high as 300g are obtained, valve weight may only be a fraction of a pound. In addition, General Controls hi-g Valves are designed for continuous or intermittent duty and are available in a wide range of AN pipe sizes or tubing connections and with a wide range of AN electrical connectors. Simplify installation and pilot supervisory operations, save weight, space, time and money—specify General Controls hi-g Valves.

Available for handling all fluids, gases, vapors and vapor mixes up to 3000 lbs. or more, in normally closed, normally open, single seated, pilot piston operated and 3- or 4-way selector valve types. Ask for descriptive Bulletin.

*TRADE MARK—hi-g indicates positive ability to operate in any position, regardless of vibration, change of motion or acceleration

GENERAL CONTROLS

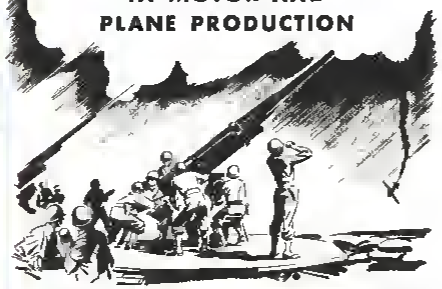
PIONEERS AND LEADERS IN THE DEVELOPMENT AND MANUFACTURE OF MAGNETIC VALVES

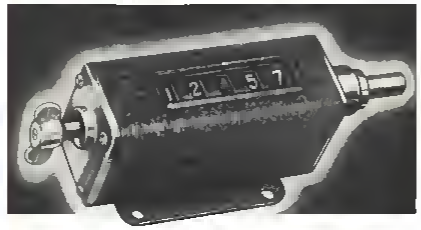
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High Speed Reset Counter for coil winders fast automatic, etc

Load each of your production machines with an inexhaustible magazine of black and white figures that will "pass the ammunition" to shoot down any raids from costly errors arising from miscounts. Equip each production machine with the proper Veeder-Root Counting Device . . . electrically or mechanically operated . . . which will roll out a continuous flow of facts-in-figures . . . providing a solid base for closer production control. These devices publish performance records in any terms. turns, strokes, operations, pieces, light-flashes, shadows, or what have you. See how raid-proof *you* can make *your* production. Write.

ARMY E NAVY

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Counting and Computing Devices

Woman to Teach Radio

In response to an appeal for civilian radio operators to teach soldier-students of the Air Forces Technical Training Command, a large group of women instructors have reported for duty at Scott Field, Ill. The women instructors will take a three-months training course. All will receive pay based on annual salary of $1,650 during the training period. Those qualifying to teach will get $2,000 a year. Civilian operators qualified to teach without additional training receive $2,000 a year upon entering the AAFTTC.

Steamships Eye Airlines

Washington (AVIATION Bureau)—The surprisingly large volumes of air cargo moved over land and sea in recent months, with still higher records to be made before the war is over, are being watched warily by steamship interests here.

Rear Adm. Howard L. Vickery, vice-chairman of the Maritime Commission declared before the American Merchant Marine Conference and the Propeller Club that air transport will be "coordinated" with surface ship lines after the war.

Dr. Henry F. Gredy, president of American President Lines, said that overseas air transport should be "unshackled" from the domestic traffic control system and advocated tie-ups between airlines and "well established" steamship lines. He maintained that airlines paralleling surface ship lines would have increased safety, that the surface lines could provide selling organizations with less overhead and that the airlines would by such tie-ups, have the advantage of steamship management experience.

Airline officials questioned by AVIATION had little to say except to point to the dire straits many of the steamship lines were in before the coming of war.



PERSONNEL CARRIER

For rapid transportation of vital personnel of the Army Air Forces, Cessna Aircraft Company has developed and put into production this new personnel transport which the AAF designates the C-78. It is constructed largely of plywood and fabric around a welded steel tubing fuselage.

Brig. Gen. A. J. Lyon

Word comes of the death of Brig. Gen. Alfred J. Lyon, USAAF, who was a victim of pneumonia contracted as a result of exposure following a recent combat flight over Germany. Gen. Lyon was a veteran Army pilot of World War I.

Calling Names

Gertrude G. Gawen, after a million and a quarter miles of flying as a UAL stewardess, has reported to Mitchell field for service as a second lieutenant in the Army's newly formed air evacuation group.

Capt. Harold N. Cheffin, Air Corps, has been awarded an Oak Leaf Cluster for safely landing his heavy bomber on an emergency field during the Jap attack on Pearl Harbor.

Edward C. Schulz is now director of Chicago & Southern's newly created personnel department. **John A. Nooney** has been named treasurer and **Robert H. Beiandar, Jr.**, acting general counsel.

TWA friends of the late Lt. Col. **Jack Zimmerman** are joining in the establishment of a Jack Zimmerman Memorial Library at Fremont, Ohio, his old home town. The library will consist exclusively of books on aviation subjects and will be installed in the Fremont H. S.

Edmund F. J. Meyer of Curtiss Wright, **Bernard W. Peck** of Rinker Aircraft and **John Short** of United Aircraft Products have been elected to membership in the Controllers Institute.

Gordon E. Graber, formerly with American Setting, is now field engineer for Lord Mfg. **George Harrington**, former field engineer, is now liaison (J-3).

Harold L. Taylor, formerly of Motorola Radio Insurance, was appointed executive vice president of the recently formed Jordanoff Aviation Company.

Clinton R. Harrower, aviation editor of The Wall Street Journal since January 1941, resigned to go with Platt Forbes Advertising Agency.

Major Theon Wright, formerly director of public relations for TWA, has been commissioned in the army and assigned to a foreign station.

Orrie Williams, is the first woman appointed as an Army Flight Instructor at Mira Loma Flight Academy. She was an instructor of civilian pilots prior to orders grounding such flyers for the duration.

"Old Timer" pilots, 113 of them whose combined years in aviation total 1,270 and whose log books list 340,032 hours, now employed by Consolidated, include **Frank Courtney, George Pomeroy, Ralph DeVore, R. A. McMakin, Doug Kelley** and **Russell Rogers**, boss of the group.

T. J. "Ted" Allen, Braniff employee since 1934, was honored by 100 fellow workers at a dinner celebration, and given a gold watch on his 40th birthday.

Acme Steel, in mailing Christmas checks to its employees included its 400 employees now in the armed services.

Clifford S. Pearson has been appointment cargo supervisor for UAL's eastern operations. UAL also announces the appointment of acting district managers at Montreal and Cleveland in the absence of men entering the armed services. **Martin J. Foley** succeeds **Leslie A. Collins** who has accepted a commission in the administration branch of the R.C.A.F. and **D. E. Wilson**, commissioned a 1st lieutenant in Naval Air Transport, has been succeeded by **Gordon B. Logan**.

Bendix Aviation's Marine Division reports that in a 24 hour drive its employees signed up for $10,000 of war bonds.

A. H. B. Jefferds, management engineer with the Trundle Engineering Co. for the past several years, has been made vice-president.

Wayman G. Jones was appointed general manager of Associated Plastics.

R. E. McOsnald has been appointed advertising manager of the Dumore Co.

Charles J. Olie takes over complete charge of purchases for Ward Leonard Electric.

Jack Frost who resigned as executive secretary of the Aircraft Parts Mfrs. Assn. to enlist in the AAF, has been assigned in the Air Transport Command. He will be succeeded by **C. M. Roberts**, formerly instructor in industrial courses at the University of Southern California.

Jacqueline Cochran has been re-elected president of the Ninety-Nines, international organization of woman pilots. This is the second consecutive time she has held the office since the incention of the club in 1929 with Amelia Earhart as president.

William Reynolds has been appointed advertising and public relations manager of the Elastic Stop Nut Corp. He is the retiring president of the National Noise Abatement Council. **William H. Kahl** has been appointed director of sales and market research.

L. R. Howes has been named sales engineer for the automotive and aeronautic departments of B. F. Goodrich.

The Air Express Division of Railway Express announces the creation of the post of air express manager in each of its four operating divisions throughout the country. The new appointees are: **Ralph W. Starkey** for eastern depts.; **P. H. Cummings** for central depts.; **M. C. Lindley** for western depts. and **V. M. Grimsley** for southern depts.

Jay R. Heymond has been appointed Newark area manager heading the express-mail-freight department of UAL.

The Air Medal has been awarded to the following members of the crew of the transport plane which carried Wendell Willkie around the world: **Capt. Alexie Klotz, Capt. John C. Wagner, Tech. Sgt. Richard T. Barrett, Master Sgt. James M. Cooper, Sgt. Victory F. Minkoff, Corp. Charles H. Reynolds.**

John L. Bunce has been elected vice president and **Fairlenge H. Flynn**, secretary of United Aircraft Service Corp.

N. M. Forsythe was elected to the position of vice president in charge of sales for Pesco.

A. R. Abell, secretary of Chain Belt Company, was elected a director and **G. O. Gilkerl**, sales manager of the Baldwin-Duckworth division, has been made general manager and also elected secretary succeeding Mr. Abell.

Dive P-47's at 725 MPH

Two Republic P-47 fighters are reported to have attained diving speeds of 725 mph. while piloted by AAF Lts. Harold Comstock and Roger Dyar. Both dives were made from the 35,000-ft. level. Lt. Comstock states that in his super-hurtle he was unable to move his elevators so stiff was the flow of air though Lt. Dyar found that he had some control. But both pilots felt oblged to crank their trim tabs in order to pull out. Comstock experienced a shuddering in his plane which the company interpreted as a possible approach to the critical speed (736 mph.) the speed of sound at sea level) at which an airfoil presumably loses its various flight characteristics.

AIRPORT ASSAULT!



PRACTICAL SUGGESTIONS TO AIRPORT OPERATORS FROM FWD ON HOW TO GET THE MOST PERFORMANCE FROM FWD SNOW REMOVAL TRUCKS

In cooperation with the aims of the U. S. Truck Conservation Program, FWD lists here some practical suggestions to enable airport operators to get the most in performance with minimum maintenance out of their FWD snow removal trucks:

CONSERVE TIRES—snow removal truck operators are universally agreed that single tires are best in snow removal service. The use of single tires of the same size on all four wheels not only conserves rubber but also reduces excessive differential action, thus prolonging the life of the truck. Closely spaced tire chains — not emergency chains — should be used on all four wheels, for maximum traction and least slippage and damage to tires.

CARE OF ENGINE — change engine oil frequently enough based on total hours of operation. Keep cooling system clean and free of rust. Control engine temperature with a radiator hood or automatic shutter.

STORING THE TRUCK — sub-zero temperatures make lubricants too stiff and solid, cause steels to become brittle. House all your trucks when not in use — avoid outdoor storage for longer truck life.

INSPECT YOUR TRUCKS — periodically and check for needed replacements — take advantage of FWD's principle of progressive interchangeability of improvements and vital parts.

SEE YOUR FWD BRANCH OR DEALER

The entire FWD organization of factory branches, FWD dealers, and district servicemen are all pledged to help you get the most out of your trucks by aiding your program of preventive maintenance. Call on them frequently for sound maintenance advice and skilled service.

THE FOUR WHEEL DRIVE AUTO CO., *Clintonville, Wisconsin*

Canadian Factory: KITCHENER, ONTARIO

FWD SNOW CLEARING TRUCKS BREAK WINTER'S BLITZ FBOM THE ATLANTIC TO THE YUKON

Hundreds of FWD's, similar to this model, fitted with mounting equipment and snowplows — are in action fighting snow as part of their regular airport maintenance work

FWD TRUCKS

—THE PREFERRED TRUCK FOR FAST, LOW-COST AIRPORT SNOW CLEARING

At airports in every state in the snow belt and many Canadian provinces (where heavy snowfalls are a constant menace) FWD four wheel-drive trucks outnumber all other types of equipment for fast, low cost snow clearing.





Aviation Manufacturing

T. P. Wright Reports oo British Production, Finds Materials Supply Ruoning Smoothly

Lessons learned in combat are translated immediately into changed airplane design in England, T P Wright chairman of the United States Aircraft Production Mission to England states in a report on his observations. Mr Wright is deputy director of the Aircraft Division of the War Production Board.

Mr Wright said the United States in gearing its aircraft production more closely to fighting experience, will continue to exchange information with the British on aircraft problems

Advanced aircraft engineering developments in England impressed Mr Wright, who emphasized the "need for courage in projecting the type of development which may contributa toward winning the war a year or two hence." Of the fighter planes now in production he praised the latest *Spitfire* and the *Mosquito*. He likewise spoke highly of the *Lancaster* bomber

Mr Wright said that British output in terms of manhours is somewhat less than the United States The factory set-up has been adjusted to the possibility of bombing which, while lessening danger from enemy planes, reduces output

The Mission visited several underground factories A frequent form of factory organization, it was found, was to locate many small plants within a limited area all of them feeding a few assembly plants. Large scale line production is difficult under these conditions It was found that single purpose machines, used in the United States as part of assembly line technique, ara less frequent in England

On the other hand, the working day of aircraft labor is about 15 percent longer than in the United States, and "it is possible thet the intensity of labor effort is somewhat greater." Mr Wright said Workers in aircraft plants, he found, "are more aware of the actual meaning of war than are the workers in this country."

Further increases In British production, he said will be the result of greatar efficiency rather than of expansion in the labor force employed. He expressed doubt that the British aircraft industry will be able to recruit additional workers to any important extant At present about 40 percent of those employed are women

Mr Wright asked at each factory how the material situation was getting along, and in not one case did the reply indicate serious holdups due to the materials shortage

He suggests that the United States should have a committee similar to the Britain s Engineering Advisory Committee which consists of six company engineers with the Secretary of the Royal Aeronautical Society acting as recorder The committee of seven advises the Minister of Aircraft Production on engineering and scientific problems on which ha wants impartial reviews

Bnister "Little WPB" Power; Namn Committee Execntiven

There is now further clarification of Charles E Wilson's "Little WPB" (page 269, December AVIATION). For WPB Chairman Nelson has issued four directives giving Vice-Chairman Wilson supervisian and production authority over aircraft

Further announcemant lists the executives who with Chairman Wilson will comprise the Aircraft Production Board They are Lt Gen William S Knudsen, Maj Gen. Oliver P. Echols, chief of the Material Command, AAF, Rear-Adm. Ralph Davison, assistant chief Navy Bureau of Aeronautics, and Ted P Wright, assistant director WPB Aircraft Division

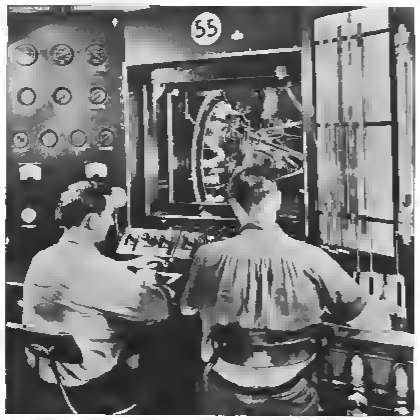
And with Mr Wilson on the Production Executive Committee are Gen Echols Adm Davison, Rear Adm. Howard Vickery, deputy chief, Maritime Commission, Ferdinand B Eberstadt, Lt. Gen. Brehon B Somervell, and Vice-Adm. S M Robinson, chief of Navy material and procurement

The four directives issued by Mr Nelson are described as 1 defining the authority of the Aircraft Production Board, 2 defining the Production Executive Committee s powers, 3 dealing with details of administration in forming Mr Wilson's staff, and 9 calling for progress reports to be regularly submitted to Mr Wilson The latter reports formerly went to Mr Nelson

Accordingly, Mr Wilson now has authority not only to supervise scheduling of production activity but also to see that orders are carried out, with power granted to check the Army, Navy, or other agencies to assure that that directives are followed and that production programs are integrated

It is pointed out thet aircraft scheduling will remain in the hands of the Army at Wright Field but personnel changes in the specific units may be made to meet Mr Wilson's requirements And he may step in and act at any time he believes reports evidence failure in the production schedule

Whether or not the Nelson directives entailed friction with the armed services is not revealed, but a joint statement by Secretary Stimson Secretary Knox and Donald Nelson emphasizes that "such questions as have arisen had to do with method, never with purpose or principle. The new arrangements give assurance that the immense production task for 1943 will be carried through to a successful conclusion."



ELECTRICITY FROM ENGINES

With this equipment devised by Pratt & Whitney and General Electric engineers, aero engines thrn generators instead of props during test runs, thus pumping electricity into plant power system Lines ge lrom test run engine to indicators within soundproofed booth, where operators determine performance. Varions engine lactories now employ this type of power recovery.

Aero Chamber Reviews 1942 Engine Prndnctinn

Recently reviewing aircraft achievement during the past year, the Aeronautical Chamber of Commerce declares that American producers of aircooled and liquid-cooled engines are turning out mora horsepower every 15 days than was produced here during the entire World War I Production of engines has jumped 240 percent in terms of horsepower

Allison Division of General Motors, meanwhile reports production 50 percent over that of a year ago, and an increase of 50 percent is expected in 1943

One of the greatest cooperative industrial entarprises of the war, the Chamber stated is Pratt & Whitney maker of aircooled engines and its six licensees to whom it has passed on its design and knowledge During the past 27 months, licensees have received, in training and manpower assistance from Pratt & Whitney the equivalant of 41 685 man-days.

Lockheed, Vegn Prndnctinn

Production of nearly as many airplanes and parts in the first six months of 1942 as they manufactured in the entire two-year period of 1940-41, is reportad by Lockheed and Vega, Despita the loss of some 10 000 trained workers to the armed services, the same pace was maintained throughout the year Now ready for production is the Lockheed *Constellation* cargo ship, reported capable of transporting more than 15 tons from the United States to Honolulu in 8½ hr It is termed the world's largest and fastest land transport

OWI Reports 49,000 Planes Made in '42; Oouble That Output Promised This Year

Washington (AVIATION Bureau)—For the third time in 1942 an official statement was made on the output of airplanes with OWI reporting that our production in the first calendar year of the war was 49 000 planes

Meanwhile it is revealed that the October output was down 5 percent but the curve is now rising as the materials supply reaches better balance under the new WPB control and production schedule

Donald Nelson said, as he announced installation of his "Little WPB" on aircraft headed by Charles E Wilson, that we will double our output in 1943 There is an official airplane production schedule for next year which cannot be published but one can easily figure it as around 100 000

Surely 150 000 airplanes in these two years will be an admirable job, and to that must be added the substantial increase in tonnage, over and above original plans plus an unmeasurable amount of new quality built into Army and Navy equipment.

In 1941 we built about 20 000 airplanes Thus our increase in 1942 was nearly 150 percent. Our increase in tonnage is in rough neighborhood of double the unit increase The numerical increase in heavy bombers since a year ago is several hundred percent—highly satisfactory

Quality increase is hard to measure but we have accomplished plenty of it in terms of fire power, armor, better communication equipment and longer range, all supported by greater engine power We have eliminated gunners' blind spots and added safety and attack facilities

The number of plants producing airframes engines, and propellers has nearly doubled in 1942—from 56 before Pearl Harbor to mora than 100 now Personnel has increased about 130 percent, says the Aero Chamber, which estimates this figure will reach 300 percent eventually The number of women employed increased during the year from 4 300 to 116 000

Under test at this time, officials say publicly, are more than a score of new fighters, bombers, and also transports. Some have flown but all are still on the secret list. These planes have new speed firepower bomb load range, ceiling, safety devices

The Detroit division of the aircraft industry announces that in the year since Dec 7 it has produced the makings of 750 heavy bombers, 1 500 medium bombers, and 4 500 fighters



ANOTHER PRODUCTION SHORTCUT

The Hafley Tube Bender, invented by Ernest L. Hellenbeck of Vega Aircraft Corp simplifies the bending of hollow tubing of from ⅛ to ⅜ in dimensions. Featuring a metal rod with a 360 deg prelracting dial and a protracting base along with a 6-ft. flexitape rule a girl can do 4½ times the amount of work per shift as the men formerly needed to do this difficult bending operation.

Oster Markn 50th Year

Golden anniversary is being celebrated this year by Ohio's Oster Manufacturing Co maker of pipe and bolt threading equipment and turret lathes Founded in 1893 by the late Herman W Oster and Russell B Tewksbury, the company currently is operating 100 percent under WPB General Preference Order E-1-b, the entire production going to the armed services and war-effort firms And sales offices are maintained in the larger cities of all neutral and unitad nations Company officers are Roger Tewksbury, president and treasurer, Arthur S Gould, vice president and Harry A. Maurer, secretary

Rules on Parts, Lumbnr

Manufacturers of aircraft and engines need not file with the OPA their prices for repair parts or specially designed airplane servicing and repair tools for which maximum prices were established in the amended Maximum Prlce Regulation No 136 (Machines and Parts and Machinery Services)

The same privilege is extended to all other manufacturers of machines and equipment which, like airplanes, ara not subject to MPR No 136 but which make repair parts or specially designed maintenance and repair tools which are subject to the regulation

All lumber used in aircraft production have been placed under dollars-and-cents maximum prices OPA announces Meantime word comes that Revised Maximum Price Regulation 166 (Aircraft Lumber) effective Dec 7, adds yellow poplar and aircraft grades of Douglas fir to the original order



TEST FIRST AERONCA BUILT PT 23

'An unusually fine, easily maneuvered craft" was report ol Carl Friedlander, Aeronca Aircraft Corp president, lellowing initial hep ol first PT 23 le ceme lrom AAC lactory Phole shows Mr Friedlander (rear 'pit) and Chief Tesl Pilot Lon Wehrung prior to takeoff

U.S.-Canndn Chnirmnn

Charles E Wilson Vice-Chairman of the War Production Board, and Harry J Carmichael, Coordinator of Production of Canada's Department of Munitions and Supply, have been appointed co-chairmen of the Joint War Production Committee of the United States and Canada, which was set up Nov 5, 1941. Mr Wilson succeeds James S Knowlson as American chairman and Mr Carmichael succeeds G K. Sheils as Canadian chairman.

Pins Hngn Transpnrts

In a recent address Tom M Girdler chairman of the boards of Consolidated and Vultae, revealed Consolidated has in development an airplane designed to carry 400 passengers at 500 mph and make non-stop round trips to Europe serving in the capacity of a bomber.

The six-engine transport design recently announced by Glenn Martin is for a 250 000-lb plane and there is also word that Martin has started development work on a 500 000-lb craft.

A completely new engineering folder on Pressure Molding available to industrial personnel when requested on company letterhead.



GET THE FACTS
ABOUT THIS *New* CASTING PROCESS

Harvill Pressure Mold Castings, covered by Army Air Forces Specification 11347, open entirely new fields of application for structural and non-structural parts and fittings. This high quality—high production—low cost Casting process is completely explained in this engineering folder, which is available to industrial personnel when requested on company letterheads (or by card or letter stating occupation).

If you are interested in hydraulic equipment, ask for the engineering folder covering the Harvill Hydraulic Hand Pumps. Outstanding design, longer life, less weight, lower costs are important features of Harvill Hydraulic Hand Pumps—which are produced by the Pressure Mold Casting process.



HARVILL Corporation

Eastern Representative
HARVILL PROCESSES CORPORATION

Consolidated "Sub-Plants"

Consolidated Aircraft Corp announces opening of the first of twelve subcontracting plants All will be owned and operated by Consolidated By establishing these plants in small communities it is foreseen that a plentiful supply of satisfactory local labor will be available while housing, transportation and other related problems, will be eliminated

Production efficiency at the test plant was found satisfactory, according to Harry Woodhead Consolidated president, and the second plant is now being installed. Women in the small communities, who could not have accepted employment in the main plants because of travel time, are accepting these jobs now available in their home communities

Begin AWPC Tunnel; Plan Another in New York

Work has been started in California on what is probably the most advanced wind tunnel ever to be built according to an announcement by the Aircraft War Production Council, of the Pacific Coast To cost $2 100 000, it is being financed by Consolidated, Douglas, Lockheed, and North American, and it will be operated by the California Institute of Technology.

An identical tunnel is to be built in New York State by Curtiss-Wright, whose Dr Norton B. Moore, with Caltech's Dr Clark B Millikan, directed the design from which both tunnels will be built. They were assisted by engineers of the four southern California companies Curtiss-Wright and Caltech Both tunnels will be equipped for testing maximum speed of approximately 700 mph.

When the West Coast tunnel is finished it will be available to all member companies of the Pacific Coast Council, which includes in addition to the sponsors Northrop, Ryan, Vega and Vultee

Report covering production achievements since Pearl Harbor of the eight southern California companies comprising the Aircraft War Production Council of the Pacific Coast, was made public last month by Harry Woodhead, president of the Council and of Consolidated and Vultee. The statement indicated that the eight companies' combined production is now greater than that of the Axis nations—and it is still mounting steadily.

Chief problems yet to be solved, Mr Woodhead said, are manpower and materials but both appear on the way to solution. If they can be brought to normal production can be increased 60 to 100 percent On a man-hour basis, 56 percent more planes were made in September than in Nov. 1941 But there was then a drop to 53 percent last October because of the loss in that month of 6626 trained men to the military services

Separations caused by personnel joining the services totalled more than 26 000 in the first ten months of last year Only 15 percent of that number were draft-inducted

Figures released indicated a combined production of $5,500 000 daily by the eight member companies. That represents an increase of 144 percent over daily volume one year ago

Cooperation achieved by the Council resulted in the exchange of 1 064 engineering reports, 6 115 lots of materials from one company to another, and a reduction of new plane development time which is estimated at 50 percent

Assembly Lines . . . By Dorsey Adams

Critical magnesium metal, fabricated into plane parts but with some minor defects which once would have caused the parts to be scrapped, can be restored to full usefulness through the new helium gas welding method perfected by Dow Chemical Co. and Northrop Aircraft. The magnesium parts can be fused by this method of welding because the members to be welded are covered with a blanket of the inert non-explosive, and non-inflammable helium gas. Oxygen cannot penetrate the helium envelope, thus oxidation of the molten metal weld is prevented.

Alcoa is working on new lightweight alloys which may make possible tensile strengths from 10 to 25 percent greater than those of any such alloy now in use. Used in plane construction, such an aluminum would mean a weight reduction of approximately 10 percent for America's fighters and bombers—a saving which could be translated into greater range for the warplanes through added fuel loads

Manner in which American aircraft manufacturers continue to find substitutes for scarce war-vital materials is illustrated in the announcement of Taylorcraft that it has perfected a method for porcelain-enameling engine exhaust stacks and mufflers to conserve the stainless steel from which the stacks once were manufactured The new process, which permits the use of lower grade metal, includes baking or firing the enameled part under temperatures much higher than those encountered in the actual use of the plane Developed as an improvement in light plane construction, the process can be applied equally well in the building of bombers and fighters

Tricycle ice cream wagons used by roadside vendors are filling a new wartime role in the plant of Consolidated, where they're now loaded not with ice cream but with airplane rivets of the types which must be refrigerated. Before the tricycle wagons were called into service, it was something of a problem to deliver the rivets, properly chilled, to the stations along the assembly lines Packed in small bags, they're now chilled by dry ice and tricycled to the required points

One of the major problems solved by the aircraft industry has been that of conversion of literally thousands of newly-hired, wholly-inexperienced persons into competent shop employees who can build planes right. The ACCA now reports on the conversion plan developed at Vultee Here, a system of position charts was set up showing at a glance information representing hours of verbal instructions. Known as "victory boards" or the "assembly line encyclopedia," the charts afford visual help in giving employees work information once obtained verbally from foremen or leadmen.

Inventor of a new parachute opening unit, Dudley Pope reports successful tests of his device to release parachutes automatically at any desired height Attached to any standard parachute, it would be useful in opening parachutes at safe levels, especially for unconscious or injured flyers unable to operate manual releases He suggests it would assure greater accuracy in delivering supplies by parachute to ground forces or fire fighters

The Defense Plant Corporation, RFC subsidiary, has authorized an increase in its contract with Boeing for additional plant facilities in the Midwest. Increase will be in excess of $2 300,000, making a total commitment in excess of $25 000 000. These facilities will be operated by Boeing while title remains in Defense Plant Corporation according to the announcement

Registration of personally-owned tools is effected in a new system at North American to cut down on tool losses Owner's name and clock number is inscribed with an electric pencil When a worker purchases a new tool from the company tool store, the store will furnish the plant protection office with a copy of the sales slip so records can be kept up to date. A periodic tool-box check up will be made

Fairchild Engine & Airplane Corp., has had its contract from the Defense Plant Corporation for additional plant facilities increased in excess of $300,000, making a total commitment of over $3 000,000 The DPC has also authorized an increase in its contract with Owens-Corning Fiberglas Corp for additional plant facilities in the Midwest This increase will be in excess of $500 000, making an over-all commitment of more than $1,800 000.



GATES VIEWS D-8 'BROODER"

Brewster's newly geared Pennsylvania dive bomber plant got Navy Department "look-see" on occasion of recent visit by Secretary of Navy for Air Artemus L. Gates (left). With Secretary (l to r) are P. M. Stephensen, plant manager; Capt. W. Carnahan (rear), chief inspector of Naval Aircraft; and C. A. Van Dusen, Brewster president.



The "Northrop group" tells how new U.S. shortcuts work to produce harder-hitting warplanes...faster!

TIME—MAN-HOURS by tens of thousands—go into template making on any new fighting plane design. For every part of the new airplane, there must be many duplicate templates, each shaped and cut and ground to an accuracy of .015 of an inch.

This has been one big reason why it has taken many months to get new airplanes of later, deadlier types rolling from the assembly lines in quantity.

It was a bottleneck which engineers of the Northrop group set out to break. After months of labor they discovered how to make identical duplicate templates by what's now known as "electrolytic etching." Today the new method turns out tens of duplicate templates in the time and with the labor formerly needed to make one.

This new process actually shortens by five precious weeks the stupendous job of putting a typical new-design, harder-hitting warplane into the air! This faster Northrop method of tooling is now being shared with other U. S. airplane makers.

Northrop is also turning over, for other manufacturers to use, the Northrop method of *welding with Helium* which has removed one barrier to the all-welded airplanes of the future.

Other aircraft companies, in turn, are informing the Northrop group of their own new-found secrets. In fact, all U. S. aircraft industry is pooling its techniques—pooling its new devices and discoveries clear down the line from blue-prints to finished planes.

That is teamwork as U. S. plane designers and plane builders understand it. It is the "makings" of victory.

NORTHROP AIRCRAFT, Inc.

Northrop Field, Hawthorne, California

MEMBER AIRCRAFT WAR PRODUCTION COUNCIL, INC.

Patterson Weighs Postwar Air Transport Forecasts, Urges Clarity of Perspective

W. A. Patterson, president of United Air Lines asserts in a prepared statement that "I feel it is important to clarify our present perspective of postwar aviation."

He cited such viewpoints as, "Inexpensive transportation is inherent in the airplane itself' and "The airplane will be completely accepted as the only suitable means of intercontinental travel."

Air transportation will augment surface transport, he said, but it will not supplant it. Surface transportation will progress as a result of air transport development.

Patterson presented figures to show that the cost of carrying 1 500 tons of freight each way between San Francisco and Chicago in one month by air would cost 25 times as much as by rail. In another set of figures he showed that a 2 400-ton load each way between Brisbane, Australia, and San Francisco would cost 250 times as much by air as by water. Again, he showed that small electric motors, valued at 30c per lb., would cost $1.50 per lb. to ship from Chicago to Australia.

Combined effect of all contemplated technical advances plus a hundred-fold increase in volume might reduce overall ton-mile costs from present average of 40c to around 10c, he estimated.

"As I see it," Patterson stated, air transportation is going to revolutionize practically every social and economic viewpoint and practice. As regards passenger travel, the airplane may well take over a major share of the volume.

The United executive said he didn't want to leave the impression "we haven't confidence in our ability to take advantage of technological advances."

Observers declared it was obvious the Patterson paper was directed to surface transport management, which has been much disturbed by enthusiastic predictions on the future of aviation, hence has been planning to enter aviation itself.

Mail Pay Cut for AA As Well as for EAL

Reduction of mail rates to 3 mill per lb.-mi. has been ordered not only for Eastern Air Lines (December, AVIATION) but also for American Airlines. Both CAB decisions also urged the companies to lower their passenger rates.

The Board estimated that it would yield about $2 425,458 mail pay per year to American. It was calculated that with present passenger and express rates the carrier would operate at a profit of $7 672 780 before income and excess profits taxes.

Eastern's mail compensation for the next twelve months is estimated at $1 335 110. Added to the estimated profits of all operations at the tariff rates now in effect, this indicates a profit for the coming year of $3 135,830 before taxes.

The Board explained that it had decided not to recapture "excess profits." Under its former decision, which American succeeded in having reconsidered, CAB would have required the company to repay over $4,000,000 to the government. American may now keep the $4 000,000 but meanwhile its mail rate has now been cut.

CAB had previously decided not to recapture Eastern's past "excess" profits. Immediately after the setting of a 3 mill rate for Eastern the Post Office Department protested that the rate was too high.

Braniff Reports on Army Work, Hiring of Women

Report by Braniff Airways on its first six months of foreign cargo operation for the U. S. Army reveals that the fleet flew 1 582 836 mi. and carried 6 545 851 lb. of materials critically needed by our armed forces.

Also revealed is that approximately 125 men left Braniff for military service in six months and that 140 women have been employed. Increasing participation by the airline in war-effort flying requires more personnel, and President T. E. Braniff says more women will be needed soon.

First of 30 new radio operators went to work for Braniff recently at the Dallas base—all women. An equal number of the airline's male operators are needed for communications along Braniff's foreign cargo lines.

Lovett Says Air Transport Cannot Supplant Shipping

Air transport is absolutely necessary to modern war, but it cannot take the place of ships stated Robert A. Lovett, assistant Secretary of War for Air, in a recent address before the Academy of Political Science. Describing himself as a "fanatic" on the future possibilities of air transport, he said nevertheless that "wild claims" of the possibilities of air carriers should be discouraged.

Mr. Lovett cited requirements to transport 100 000 long tons of freight a month from this country to Australia. It could be done, he said, with 44 surface ships, with crews totalling 3,200 men and using 165,000 bbl. of fuel. But by air, 10 022 four-engine planes, with a flight personnel of 120,765 men would be needed, and they would require 2,995 614 bbl. of fuel outside this country. It would take 85 large new tankers to transport their fuel.

On the other hand, to show the invaluable service that air transport can render, Mr. Lovett said that in five days our air transport command flew 25 000 lb. of much needed anti-aircraft and anti-tank ammunition from this country to the Egyptian front early last summer.

Rejects United Claim

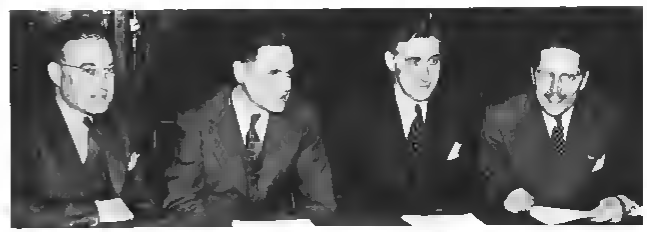
The Court of Claims has rejected the suit of United Air Lines and two subsidiaries for $2,477,774 damages stated to have been suffered as a result of the government's cancellation of airmail contracts in 1934.

The court awarded the claimants judgments amounting to $364 423 for services prior to annulment of the contract, then held that the cancellation did not constitute breach of contracts. It also rejected the government's counter-claims. The company has the right to appeal to the Supreme Court (writ of certiorari or review of the record).

New Air Cargo Body Has 5-Point Program

Formation of a permanent organization to prepare both aircraft builders and the American shipping industry for global air transport, is announced with the creation of the Air Cargo Research Association Los Angeles with Thomas Wolfe, vice-president of traffic for Western Air Lines, as general chairman. A five-point program has been launched to do research work which will increase aerial shipping.

The committee will provide information seeking 1. to educate cargo handlers in proper loading and unloading of aircraft; 2. to standardize packaging, 3. to formulate



THEY NOW GUIDE ATC OF ATA

Recent annual election meeting of Air Traffic Conference of Air Transport Association in Chicago saw new officers inducted. Directing commercial airlines traffic governing body for new year are (l. to r.) M. F. Redfern, executive secretary ATA, Nelson E. Fry, traffic manager, UAL, Chicago named vice-president, Vincent P. Conroy, traffic vice-president TWA, Kansas City, elected president, and Charles Beard, traffic vice-president, Braniff Airways, Dallas new first vice-president.

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as essential Career Training which fits the graduate to meet every requirement for Civilian Employment as a Maintenance Mechanic on Army Airplanes and on Commercial Airplanes.

If it averages *twenty* mechanics to keep *one* airplane in the air, it will take 1,000,000 mechanics to keep 50,000 planes in the air.

No other type of expert is as badly needed as the Master Airplane and Engine Mechanic.

If you want a training that will put you *to* work and keep you *at* work—*now and after the war*—sign and mail the coupon below and *do it now*.

We can accept only thirty students per month.

1943 Classes Start Monday, January 4, and every fourth Monday thereafter.

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A, JAN 1943

container specifications with particular emphasis on methods and materials used; 4 to study loading problems with relation to lifting-apparatus for loading through plane doors, stowage methods, and transportation methods in connection with hauls between warehouses and planes; and 5 to cooperate with aircraft engineers in the development of new designs and fittings for airplanes specially adapted to aerial freight transportation.

Other officers and chairmen of the association are James F. Hall, North American Aviation, Inc., first vice-chairman; Gordon Brown, Douglas Aircraft Co., second vice-chairman; Jack B. Sheehan, Lockheed Aircraft Corp., secretary; William A. Lippman, treasurer; Ralph E. Oursler, Lockheed, statistics and research chairman; Robert Welliver, Douglas, container and package specifications chairman; Robert Reedy, Vega Aircraft Corp., engineering and transportation chairman; Kenneth L. Vore, Vultee Aircraft, Inc., organization chairman; and Glen B. Eastburn, Los Angeles Chamber of Commerce, public relations chairman.

Air Express Up 90%

A total of 15,085,345 lb. of air express was handled by the airlines in the first nine months of 1942, compared with 7,927,181 lb. in the same period of 1941—an increase of 90 percent. Shipments totaled 1,033,761 as against the 41 record of 947,760.

Fact that this large increase was carried by the airlines in approximately half the number of planes operated last year attests the efficiency and improved coordination of scheduled operations by the lines.

UAL "Commando" Course

Army Air Forces mechanics in training at United Air Lines Boeing School of Aeronautics has set up a "Commando" course. The 100-yd. track is laid out on loose rock and sand surfaces and has all the hurdles, fences, poles and other obstacles which might be met on air fields at foreign combat zones. The idea is to toughen the men for quick work in getting planes under cover, or ready for a quick takeoff.

Test Navigation Method

A new procedure for celestial navigation, evolved by Dr. Samuel Herrick, University of California Astronomy instructor, is being tested by Pan American Airways, United Air Lines and the Air Transport Command of the AAF. Courses including the new procedure, have been announced by the university's extension division.

TWA Offers Varied Training

Instruction in ground work and instrument flying is now being given by TWA to a number of Army pilots, announces Vice-President Paul Richter. Frank Busch, veteran TWA flight-captain, is in charge of the school.

In addition to training copilots, navigators, and radio operators, TWA is also now teaching young women to become junior and assistant meteorologists. After completing the three-month course, they will be assigned to various stations for additional training under the guidance of senior airline meteorologists.



To qualify college-educated women as junior meteorologists for its airline stations, TWA has launched a special three-month course. Here, J. A. Browne, chief meteorological instructor, symbolizes airline weather station functions for edification of (l. to r.) Students Helen Stewart and Martha Mitchell.

For The First Time

a reversing dynamic-braking aircraft contactor



for the control of 12- or 24-volt series wound d-c motors

The Army-Navy "E" for Excellence is the manufacture of war equipment. Now flies over the G-E plants employing 100,000 men and women.

SAVES SPACE AND WEIGHT

This new G-E contactor takes the place of at least three single-purpose relays. Weighing considerably less and taking up only a small fraction of the space required by the relays it replaces, this contactor will reliably start, dynamic-brake, and reverse 12- or 24-volt, d-c motors having full-load currents up to 10 amperes and locked-rotor currents up to 60 amperes.

ELIMINATES COMPLICATED INTERLOCKS

This small, lightweight contactor elimnates all the complicated electrical and mechanical interlocks that are required when single-purpose relays are used for reversing and dynamic-braking. A few terminal connections are all that are necessary to install it.

MEETS TNESE U. S. GOVT. REQUIREMENTS

200-hour salt-spray test as stipulated by various government agencies

U. S. Government vibration stipulations.

Suitable for use at altitudes from sea level to 40,000 ft.

Withstand linear acceleration of 10 G applied in any direction

Operate at temperatures from −40 C to 95 C.

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A collection of well-illustrated bulletins which give full details on the new General Electric line of aircraft control. Yours for the asking—all in a durable binder. Just send a card requesting your copy—later bulletins on new devices will be mailed to you when issued. Address *General Electric, Schenectady, N. Y.*

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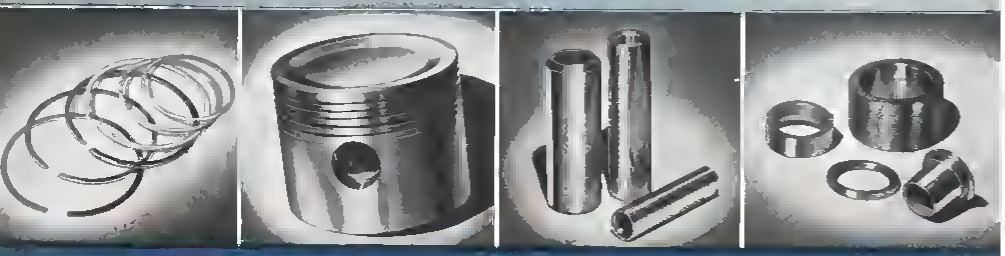
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McQUAY-NORRIS MFG. CO. (AIRCRAFT DIVISION), ST. LOUIS, U. S. A.

Bombs vs. Nazi Production

Small aircraft factories have received somewhat more consideration in Germany of late While there is very little news in the German press about aircraft production the little there is seems to indicate that more orders have recently been placed with small firms, especially in the Eastern Provinces of the Reich

Makers of component parts, accessories and instruments are most prominent but it now also appears that the small manufacturers are getting orders for larger units Main reason seems to be that the larger factories cannot cope with production at the usual rate, almost certainly because of RAF raids on industrial centers

It is rather remarkable that dispersion of production centers in Germany had merely called for placement of buildings in such groups that an entire production line could not be knocked out by one bomb However the recent 4-ton bombs which the RAF has been showering on Germany are capable of incapacitating great parts of such plant layouts This is also borne out by the fact that many of the larger manufacturers are now opening branch plants in smaller towns in some cases a considerable distance away from the main factory

U.S.-British Cooperation

One of England's most outstanding engine designers Sir Roy Fedden, has been sent to this country as representative for the British Ministry of Aircraft Production Sir Roy was chief engineer for the Bristol Aeroplane Co for 20 years only recently leaving this post where he was responsible for many of the famous Bristol engines

Differences of opinion between the commercial and technical factions at Bristol were said to be the cause of Sir Roy Fedden's separation

Nazi Plants in France

More and more German plants are being opened in factories once belonging to French manufacturers the most important new one being the pilot plant of Heinkel for production of a new plane the Heinkel 274 equipped with four of the new BMW-802's and having a gross weight of 90 000 lb The prototype is expected to fly in the spring No large scale production can be expected for another year—and not then if the RAF and USAAF get there first

Other plants, shut down because their workers have been sent to Germany under Laval's edict are now reopening and are in the process of expanding their manufacturing facilities obviously to go into production for the Nazis now that individual French efforts have been completely halted

About That Mosquito

Though officially described as a reconnaissance bomber, it's now indicated that the RAF's deHavilland *Mosquito* will find a much wider field of activity Details are by no means complete and most performance figures are a tight secret, though demonstrations seem to indicate a top speed approaching that of modern fighters

This midwing plane has a 41 ft length and a 54 ft span, with a height of 15 ft It is of simple wooden construction which lends itself to widely dispersed manufacture Both main wheels and tailwheel are retractable and the whole design has resulted in a very low drag, allowing the *Mosquito* to be used both for long range and high speed missions

Armament varies may consist of either four 20-mm cannon or a larger number of machine guns all mounted in the wings The plane itself shows a marked resemblance to the deHavilland *Comet* of Melbourne race fame, thus appears to support rumors bandied during '39 and '40 that the *Comet* was being used as a new military plane prototype. DeHavilland has made no other operational aircraft in this war, though the company contributed quite a number of aircraft famous in World War I some of which were used later in America

New German Equipment

The new BMW plant in Munich is expected to concentrate on the production of BMW-802's, a new 18-cyl air-cooled radial engine of 2,000 hp. bearing striking resemblance to the twin-row Wrights and P&W's This engine will be used for modified types of the FW-190 and Do-217 which have proven to be underpowered when encountering new Allied aircraft

Also coming into production in French plants is the Siebel 204 a twin-engined machine with two As410 engines of 450 hp This plane is a model built in 1939 for private use It can carry up to six passengers

On the Eastern front, a new transport plane as yet unidentified, has been seen on several occasions Twin-engined with tail surfaces carried on booms and using tricycle landing-gear together with the special high-lift devices, the plane might be a product of Fieseler which is known to have been working for some time on aircraft of this type Gross weight is said to be 40 000 lb., with a cargo capacity of about half that figure

German Research

All aeronautical research in Germany has now been brought together under a Director of Research in the Air Ministry who reports directly to Goering Main reason for this change seems to be the great number of research institutes which have been established, all working enthusiastically on their own pet projects without paying much attention to the efforts of their fellow researchers

Another reason is the urgent need of the German Army for manpower, which necessitates control over research to eliminate duplication of effort. Central control of a person with authority also results in increased attention to new discoveries by members of the new armament commissions

Canadian News

By James Montagnes

Canadian girls, 18 to 30 years old, are now being trained as civilian traffic control assistants The Canadian Civil Service Commission has opened jobs at seven centers for a group of 32 girls They will be trained for traffic control work as part of the program of expansion being undertaken by the civil aviation branch of the Department of Transport in its airport and airway traffic control system The women are expected to have had some aviation flying training preferably with a pilot's license, or secondly to have had some aviation experience Salaries start at $1,200 annually, plus cost-of-living bonus

Canada's own version of the PBY flying boat to be called the *Canso-A*, is 63 ft long has a wing spread of 104 ft., stands 20 ft high, and has a hull width of 10 ft 2 in The aircraft differs from the original *Catalina* in that it has two gun blisters with firing arcs to the rear There is also a nose turret, likewise a tunnel gun behind the rear steps to look



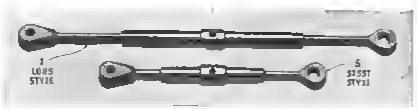
YANKS BROUGHT RUNWAY WITH THEM

International News photo

It was this very practical steel strip mat runway which quickly made operations click at Guadalcanal's Henderson Field once it was wrested from the Japs Mat which neatly facilitates takeoffs and landings of such big planes as Army B-17 shown here, is laid in small sections, can easily be repaired

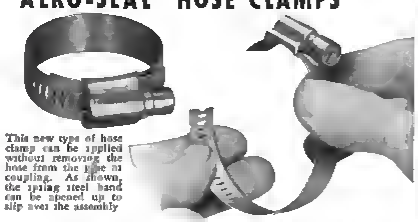
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AIRCRAFT TURNBUCKLES



Made to Army-Navy specifications in regular assemblies known as Types AN130, AN135, AN140, and AC150 (designating specific combinations of cable eye, pin eye, and fork ends). Two styles are available, Long and Short, as shown in the picture above. Short styles in various sizes have tensile strength ratings from 800 to 4600 pounds, Long styles from 1600 to 17,500 pounds. Components may be ordered separately for ultimate combination on the manufacturer's final assembly line. Rigid quality control maintained throughout all manufacturing operations. Made on high production precision machinery, formerly used on commercial products.

"AERO-SEAL" HOSE CLAMPS



This new type of hose clamp can be applied without removing the hose from the pipe or coupling. As shown, the spring steel band can be spread up to slip over the assembly

Extra-long take-up in the band gives maximum size coverage with a minimum number of clamp sizes. Uniform squeeze is obtained by a belt-like tightening action. Easy operation, with worm and worm gear action. Slotted head on screw has rim to prevent screwdriver from slipping. Design extremely compact. For hoses 1" diameter and larger. Quality construction throughout.



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AIRCRAFT STANDARD PARTS CO.

after attacks from below. The ships are camouflaged gray blue, plus white underneath in patch pattern. It carries a crew of eight with bunks for four, has an electric stove, fresh water facilities, a unit for distilling sea water, and a gasoline-burning heater. It has tricycle landing gear, two center wheels and one at the nose, is equipped to stay aloft 28 hr at 199 m.p.h., is made of an aluminum alloy, is to be used for anti-submarine duty and reconnaissance work, and will be able to carry bombs, depth charges, and torpedoes. The first all-Canadian-built *Catalina* amphibian made its maiden flight in December. Canadian Vickers constructed it.

Trans-Canada Air Lines, publicly-owned Canadian airline, carried record traffic during October with 10,822 passengers and 245,736 lb of mail. Air express increased by 43 114 lb. over October of 1941. Trans-Canada Air Lines recently revised its schedules, now flies 22 670 mi. per day.

Reorganization of RCAF elementary flying training schools was effected early in December, bringing civilian operated schools more directly under RCAF service control. These schools had been under private companies, primarily with civilian instructors, except for certain sergeant instructors on loan. Existing personnel is being absorbed into the RCAF, and in the future all schools will be RCAF staffed. Main reason for the reorganization is the unavailability of qualified civilian instructors. Under the new set-up, the representative of the operating company will be known as the manager, and the chief flying instructor will be given an RCAF commission and will be senior RCAF officer at the school.

The "Mosquito" fighter-bomber will have its most important production line in Canada, according to Ralph P. Bell, director-general of Canadian aircraft production. The *Mosquito* is being built at a Dominion deHavilland plant.

A Joint Committee for Standardization of Air Training in North America has been formed as a result of last summer's Ottawa Air Training Conference. Committee chairman is to be Maj. Gen. Yount, U. S. A., and Canada will be represented by Air Vice-Marshal R. Leckie, air member for training in the Canadian Air Council. It is understood that one of the major questions to be discussed and put into operation is the training of United States recruits in Canada, which has ample air training facilities under the British Commonwealth Air Training Plan. Another proposal made is the training of United States recruits in Canada, which has ample air training facilities under the British Commonwealth Air Training Plan. Another project is the training in Canada of Americans who are over-age for the USAAF. United States training age limit is 26. In Canada it is 31.

F. T. Smye, Hamilton, Ont., executive, formerly executive assistant to Ralph P. Bell, director-general of aircraft production, has been appointed director of the production program, aircraft production branch of the Department of Munitions and Supply.

The Canadian government during November took over the ownership and management of the aircraft plant of the National Steel Car Corp., Ltd., where *Lancaster* bombers and other aircraft are being manufactured, assembled and overhauled. Reason for this move: To expedite operations and maintain cooperation between plant management, Department of Munitions and Supply, and builders of the *Lancaster* in Britain. The plant is to be operated by Victory Aircraft, Ltd., a wholly-owned government company of which J. P. Bickell, Toronto mining magnate is president. Compensation to be paid National Steel Car is to be determined by agreement, or under statutory expropriation procedure. The step was taken to assure continuance and completion of the *Lancaster* program.

This year has been the biggest in the history of Canadian airfield construction. Canada now has approximately 200 fields in operation, many of them hacked out of almost inaccessible wilderness, where before the war the white man scarcely even set foot. And the areas acquired for these fields would equal a half-mile strip around the world at the equator. In the past few months, work has been rushed on new sites to make them available for winter flying. When spring thaws the ground, these winter bases will go out of use until permanent runways can be installed. Hangars and lighting systems will be installed at these new fields this winter.

Canadian aircraft labor conditions have been under review by government labor committees for some months. Latest case to be settled is that of the Fleet Aircraft Corp. and its employees designed to prevent strikes and lockouts. The agreement provides for an 8 hr. day and 48 hr. week, time and a half for overtime, regular rest periods, leaves of absence without loss of seniority for men in military services and equal pay for women. The pact also provides for a grievance committee, and recognizes the Fleet Aircraft Workers' Association affiliated with the Canadian Aircraft Works Organization, as the only legitimate bargaining body. Nearly 2 000 workers are affected.

MSFU Unveiled

The Merchant Ship Fighter Unit which uses so-called *Catafighters*, airplanes attached to merchant ships and catapulted into the air in case of long-range bomber attacks, recently celebrated its first birthday. Built up through cooperation of the RAF Navy and Merchant Marine, crews and planes are supplied by the RAF catapult equipment and Fighter Direction Officers by the Navy and ships and general personnel by the Merchant Marine. Final decision on catapulting rests with the master of the CAM ship. Since these planes have gone into service, not one merchant ship has been lost from long-range bombing attacks, even though some of the planes are naturally lost after each action.

Indian Plant In Full Swing

Somewhere in the middle of India a new aircraft plant is coming into full production—the brainchild of an enterprising American and a modern Indian business man. The original idea to start the Hindustan Aircraft Corporation came from Walchand Hirachand, who managed to interest William Pawley of Intercontinent, who had already built large plants out of the ruins of China. Ground was broken some 20 months ago, and since then the ratio of foreign workers has steadily decreased till the plant is now run mainly with Indian help. Raw materials are coming from India itself as much as possible.

ATA Anniversary

England's Air Transport Auxiliary was three years old in mid-September, during which years it delivered 100,000 planes in 225,000 flying hours over 30 000 000 mi.

On Schedule . . . by "Vista"

Commercial airlines still being operated by Germany in Europe have now been cut down to the absolute minimum, one of the latest being the elimination of the link with Lisbon, which had been running via Vichy, France. The current sparse news seems to indicate that Lufthansa, once the most plentifully equipped airline in Europe, has been stripped of all aircraft which could serve a possible military purpose. Lufthansa's mainstay craft—the sturdy Junkers 52-3m's—have been seen in great numbers over both the African and Russian fronts, rushing up troops and equipment. Many of these planes appear to have just come off the commercial services, only being armed with a few light machine guns.

At the same time, some of the Nazis' newest large planes have been pressed into military service too. Notably, the Blohm & Voss BV-222, a sizeable flying boat originally designed for transatlantic service, has been converted into a troop carrier, and several of them have been shot down over the Mediterranean. The 150-ft.-span plane weighs some 90 000 lb. loaded, and is powered by six BMW 1 000-hp. engines. It may be said to be but slightly larger than the Boeing 314s. The craft's use of six 1,000-hp. engines, instead of the larger 1 500 hp. engines made by the same concern, seems to indicate that this plane was designed around the start of the war.

In Switzerland attention is still being focussed on post-war plans, especially since it is generally felt that the increasing fuel capacity and range of modern aircraft will finally eliminate the use of Swiss airfields as half-way stopping places. This development is generally expected to force this small country to provide sufficient air services to meet its own service demands and to allow for a general junction with the postwar airline network. At the same time, Swiss authorities are working on a continuation of the International Air Traffic Association's (IATA) activities, in that a general compilation of laws and rules pertaining to aerial traffic with its many legal and technical aspects, is being drawn up for possible future use.

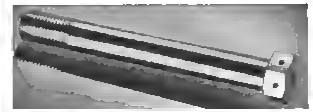
SEE AERO SCREW COMPANY FOR...

DRILLED FILLISTER HEAD MACHINE SCREWS



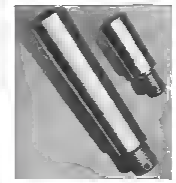
Used in many assembly operations and hence available in several types and a wide range of sizes. Low-carbon screws, for ordinary uses where high strength and close tolerances are not required, made to Air Force drawings AC500A and AC501A. Heat-treated nickel steel screws, for more particular applications where screws are appreciably stressed, conform to Army-Navy drawings AN502 and AC503. For close positions, where double cross drilling is desirable, nickel steel screws conform to Navy drawing NAF 1164. Plating is bright and uniform. Nickel steel items identified by "X" on head.

STEEL DRILLED HEAD AIRCRAFT BOLTS



Generally known as "Engine Bolts" and widely used in aircraft construction where bolts with heads drilled to accommodate lock wire are required. Holes drilled through all faces to meet center hole in top of hexagon head. Made of heat-treated nickel steel to conform with Army-Navy specifications, in types AN73 through AN81 and sizes up to 6" length. Also in coarse thread (NC3) or fine thread (NF3) styles. Carefully inspected and tested for quality, accuracy, and uniformity. Cadmium plating conforms to AN-QQ-P-421. Identified by "X" on head.

THREADED TAPER PINS



Specially-designed pins, generally used in aircraft construction in place of commercial taper pins. Made to conform with Air Force drawing AC386 in sizes from 1 through 5. Can be furnished with threaded end either drilled or not drilled for cotter pin. Material is nickel steel of Army-Navy AN-QQ-S-624 specification, cadmium plated in accordance with AN-QQ-P-421. Centerless ground after hardening to insure accuracy and uniformity. Companion AN975 washers also available.

CATALOG AND ENGINEERING DATA

Send for your copy of new Catalog No. 101, showing complete prices and engineering data on Hexagon and Drilled Head Bolts, Clevis Bolts and Pins, Fillister and Washer Head Screws, and Threaded Taper Pins.

AERO SCREW COMPANY
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Sharp, jagged, destructive! Not bombs. Merely little specks of dust . . . but far from harmless, as high-powered microscopes would show.

It is easy to imagine what damage these hard, jagged particles can do to precision finished bearing surfaces in equipment ranging from delicate instruments to heavy machines. When a highly finished part must be scrapped because of dust-damage, much more is lost than just a piece of metal. Many hours of expensive, painstaking labor are completely wasted.

One of the best defenses against dust-sabotage is air conditioning . . . the specially designed kind of air conditioning which, through efficient air filtering and accurate control of temperature and humidity, is making possible precision tolerances never before attainable.

General Electric has taken an outstanding part in the development of this new air conditioning. Already, the war has taught us how to make equipment more compact, more flexible, and far more efficient. Required "climates" are faithfully reproduced. When the war is over, air conditioning . . . better, cheaper, more universally used . . . will do much to make the world of the future happier and more useful for everyone. Then, as now—General Electric will be a leading source of all kinds of air conditioning.

Air Conditioning and Commercial Refrigeration Department, Division 431, General Electric Co., Bloomfield, N. J.

Air Conditioning by

GENERAL ELECTRIC

Aircraft stockholders will have a long wait for their 1942 annual reports since managements of all types of industrial companies say they will be unable to get out their yearly financial statements with the usual dispatch. Thinning lines of office help overburdened public accountants, complicated tax regulations, and contract renegotiations all are combining to set back annual reports from three to six weeks. Eventually reports will be ready—minus any data that might be remotely of aid to the enemy.

Aircraft plant expansions are still continuing, although WPB has called a halt to new construction in nearly all other phases of the war effort. Some of the recent Defense Plant Corp. contracts for additional plant facilities include: **Republic Aviation**, $9,000,000; **Liberty Aircraft Products Corp.**, $300,000, and **Ex-Cell-O Corp.**, $450,000.

Bendix Aviation recently declared a year-end dividend which brought 1942 payments up to $3.75 per common share as compared with $4 per share in 1941, while **Sperry Corp.** made a payment of 75c. that brought 1942 disbursements to $1.50 a share against $2 the preceding year. At the same time **Thompson Products** declared a 25c. dividend which made a 1942 total of $1.50, compared with $2.50 in 1941.

Bell Aircraft, according to a Wall Street report, is another aircraft company, which is considering a loan of the V-type, the new bank financing method that is steadily growing in favor in both the aircraft and automobile industry. The Bell loan may run to $30,000,000. At the same time, Chicago reports have it that **Borg-Warner Corp.** is considering a loan for a similar amount. **Electric Auto-Lite** has arranged a $17,000,000 three-year loan to finance its war production program.

Five auto industry leaders, at a recent press conference in Detroit, expressed the collective opinion that the aircraft industry probably offers less attraction to the auto industry as a field for postwar expansion than the auto business may offer to the aircraft companies in the future. This interesting expression follows rumors that several leading aircraft companies were contemplating entering the motor car field after the war.

Chicago & Southern Air Lines called its preference stock for redemption on Jan. 1 at $12.50 a share. The issue was convertible on the basis of two shares of common for each share of preference stock. Publication of nine months' earnings figures by several airlines caused the majority of air transport stocks listed on the New York markets to establish new highs. Here, partly, is the reason **American Airlines** reported net earnings of $3.91 a share against $3.38 in the like 1941 period and declared a $1.50 common dividend. **United Air Lines** earned $1.34 a share, against 83c. last year, and **Western Air Lines** reported a net of $1.22 a common share for the nine months against 4c. in the like 1941 period.

Further good news for the airline stocks centered around the CAB decision to drop its plan to recapture air mail "excess" pay. This meant that **American Airlines, Eastern Air Lines,** and **Pan American-Grace Airways** will not have to return several millions of earned income to the Treasury. But current mail payments were reduced, and the airlines generally were served notice that the day is not far off when domestic airlines will be able to operate profitably without a government air mail subsidy.

Cessna Aircraft reported net earnings of $738,202 for the year ended Sept. 30, 1942, or $2.11 a common share, as against $1,796,594 or $5.13 in the like 1941 fiscal year. Net sales were $37,565,529 compared with $13,646,040 in 1941. The company has made provision for a government refund of $4,800,000 on renegotiation of war contracts. Subsequent to Sept. 30 War Department officials proposed a downward adjustment of net profit amounting to $1,850,000 (before federal and state income taxes). This proposal has been rejected by the management. Net income for the 1942 fiscal year, however, remains subject to any renegotiation adjustment consummated between the company and the government.

Packard Motor Co. estimated 1942 sales at about $240,000,000 — two and one-quarter times its greatest peacetime volume. The company has reached capacity operations on marine engines but expects to increase its output of Rolls Royce aircraft engines substantially in each of the next six months. Production was said to be three weeks ahead of schedule at the year-end.

Nash-Kelvinator Corp., which is producing Pratt & Whitney engines in ten of its plants expects to reach peak output in this year when dollar volume will be four times normal peacetime business. Nash reported earnings of $3,828,755 or 89c. a common share, for the fiscal year ended Sept. 30, 1942, as compared with $4,917,052, or $1.07, in the 1941 fiscal year. The company, which also has a large propeller contract, recently relinquished a naval contract for the manufacture of cargo planes.

Lockheed Aircraft Corp. has registered with the SEC a $174,000 issue of participations in its new employees' retirement plan. The plan is for the benefit of employees, officers, and directors. Trustees of the fund may invest proceeds in annuity contracts or United States government securities.

Beech Aircraft reports sales of $59,582,353 for the fiscal year ended Sept. 15, 1942 as against $6,052,204 in the preceding year. Net earnings amounted to $2,417,919, or $6.04 a share, compared with $471,715, or $1.17 a share, in the 1941 fiscal year. Earnings for the past year are subject to renegotiation of contracts the War Department having proposed a $2,715,375 downward adjustment of earnings before taxes. The company has rejected the proposal.

Fairchild Aircraft of Canada, Ltd., Montreal, reports net profit for the year ending June 30, 1942, of $99,540 compared with $39,429 in the previous year. President H. M. Passmore reported at the annual meeting that the company's production of aircraft was more than four times that of the previous year. When extensions to the company's plant now under construction are completed, the company will have 600,000 sq. ft. of floor space compared to 39,000 sq. ft. in 1937.

Common dividend payments of 13 primary aircraft manufacturing companies in 1942 and 1941 are tabulated below:

	1942	1941
Aviation Corp.	$0.25	$0.15
Beech	1.00	none
Bell	2.00	2.00
Boeing	1.00	none
Cessna	1.00	1.00
Consolidated	2.00	2.00
Curtiss-Wright	1.00	1.00
Douglas	5.00	5.00
Lockheed	2.00	2.00
Martin	1.50	1.50
North American	3.00	3.00
United Aircraft	4.00	4.00
Vultee	0.50	none

Merger of **Vultee Aircraft** and **Consolidated Aircraft** probably will be effected this coming spring, according to Wall Street reports. Vultee owns approximately 34 percent of the outstanding Consolidated capital stock, according to the last official tabulation.

Solar Aircraft raised its 1942 dividend payments to 20c a share as compared with 10c in 1941, while **United Aircraft Products Co.** paid $3 a share last year against $4 a share in 1941. **Continental Motors** disbursed $1.50 a share in both years, while **National Aviation** declared dividends of 92½c. a share in 1942 against

By RAYMOND HOADLEY

MANUFACTURE of aircraft became America's leading industry in 1942. For output of this new industrial giant ran in the neighborhood of $4,500,000,000 in the year just ended—a larger dollar volume by far than the automobile industry ever realized in its best year. This record 1942 dollar volume compares with $1,650,000,000 in 1941, $544,000,000 in 1940, and $225,000,000 in 1939.

But that is only half the story. More than $2,000,000,000 has been expended by the government and the aircraft industry in plant and equipment in the past two years. Furthermore, unfilled orders, which totaled around $8,500,000,000 a year ago, are several times that amount today. A number of aircraft companies have unfilled orders in excess of $1,000,000,000. There are more than 100 plants building planes, engines and propellers and in those plants there are 115,000 women employed as against 5,000 a year ago. Next year all these statistics will become more astronomical than they are here at the 1942 year-end.

The dividend tabulation of 13 primary aircraft manufacturing companies (see accompanying column) shows that stockholders have not done badly this year. Of the manufacturers represented in the tabulation six paid the same dividend as in 1941, three disbursed a smaller amount, one increased its payment over a year ago, and three declared initial dividends in 1942. A few more of the larger companies were still to be heard from when this was written.

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For Rolled Metal Sections

Year after year, mile after mile of metal channels, edgings, nosings, trim, etc. have come from Kinkead's "built-for-the-job" precision rolling equipment. Now—major aircraft builders are depending on Kinkead's production facilities—some for specially designed roll-formed structural members—others for sections to take the place of "hard to get" extrusions.

You Can Depend on KINKEAD for Close Tolerance Requirements

Kinkead rolls aircraft alloys in big volume to much closer tolerances than obtainable by many production methods now employed in the aircraft industry. Kinkead's high production speed insures a low ratio of die cost while meeting your close tolerance requirements of special channels, angles, stringers, hat sections, Z bars and substitutes for aluminum extrusions. Shapes rolled by Kinkead can be designed for an unusually favorable ratio of strength to weight.

KINKEAD Experience and Production Methods are Available to You Now!

Kinkead production is fast and dependable. Every Kinkead rolling machine is operated by exacting craftsmen—precision trained crews with specialized experience. They know your needs and they meet them. Same way with our drilling, punching, buffing operators—they know the high Kinkead standards and they meet them.

WHAT ARE YOUR SPECIFICATIONS?

We will be glad to put before you detailed data regarding our capacity, experience and ability to produce rolled aircraft sections to your exact specifications. Our specialized knowledge and equipment is at your service.

WRITE—WIRE—PHONE—NOW!

PLANT OFFICIAL CONTACT: W. S. Kinkead—B. W. Brooks

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only 5c. a share in 1941. American Airlines remained one of the few air transport concerns to make dividend payments, distributing $1.50 a share to stockholders in both 1942 and 1941.

Brewster Aeronautical Corp. has filed suit in the U. S. District Court at Philadelphia against James Work, former president, P. N. Stevenson, former vice-president and J. Griffin Boerdman, former director, to have them held liable for the return of more than $3,000,000 paid to the Miranda brothers in alleged illegal commissions on the sales of aircraft equipment to foreign countries.

Fairchild Aviation, in a report for the nine months ended Sept. 30, 1942, showed net earnings of $699,568 equal to $1.39 a capital share as compared with net of $866,783, or $1.88 a share, in the like 1941 period.

Square D Co. reported net earnings of $1,564,577 for the first nine months of 1942, equal to $3.55 a share as compared with $2,255,870, or $5.17 a share, in the corresponding 1941 period. Certain contracts may be renegotiated.

Oe the Rew Materials Froet

MOST AUTHORITIES agree that copper represents the most critical shortage among the vital war metals although the tight situation in steel and in some of the others seem to receive more attention in the press. Shells and tanks and naval vessels eat up enormous amounts of the red metal.

But meanwhile aircraft production requires more copper than the average person realizes. The big four-engine *Flying Fortresses* and *Liberators*, for example, use more than 1½ tons of copper apiece while one type of fighter plane takes more than 800 lb.

Copper, like aluminum, is one of the most severely rationed metals today, with every pound going into direct military orders, lease-lend, or highly essential industrial uses. The amount of copper going into electric systems communications, chemical plants, and other industrial purposes, today accounts for only one-fifth of the total supply.

At the same time, the current supply of 200,000 tons a month is the largest in the nation's history and is more than twice the 1938 production. Subsidies have boosted the output of high-cost mines in the United States, Canada, and South America.

Steel is being substituted for copper in the making of shell cases in an attempt to take some of the pressure off copper. Steel is short, but copper is shorter. Copper is non-replaceable for many essential military purposes, and in view of its limited supply, some other critical materials must be substituted for it when possible.

Uncle Sam's copper supply this year will be greater than that of the whole world in 1938, the last full peacetime year. Yet estimated essential requirements in 1942 were 8 percent in excess of the visible copper supply, while this year they will be 25 percent above the maximum present supply. Fact is that the 1943 copper supply will determine the amounts of munitions and war material that the United States can produce in several major categories.

Tank production, for instance, has been curtailed to about 50 percent of the capacity of several of the tank arsenals in order that copper and some other critical materials as well, may be diverted to aircraft and shipbuilding. Reductions in the output of other armed vehicles have been made. A medium tank takes almost a half ton of copper. A scout car takes 150 lb.

What can be done to make more copper available? First of all, the manpower situation must be solved. Last year the domestic copper companies estimated that 5,000 tons of copper were lost a month because of the drift of manpower away from the mines to more lucrative war industries and into the armed services. The absentee problem also reached alarming proportions. Mine wages have been "upped" recently, and the drafting of manpower from the mines has been halted.

Copper subsidies have been increased and larger imports are expected. Most of Canada's red metal exports go to Great Britain at a price, incidentally, approximately 25 percent below that prevailing in the United States. However, our government has contracted to bring in from 40,000 to 50,000 tons of high-cost copper from the Dominion this year. Rationing will be tightened further, substitution will increase, and copper scrap will be requisitioned by the government in cases where it cannot be obtained voluntarily.

How much the supply can be increased by these means, war production officials are unable to estimate. But it should be substantial. Meanwhile, copper will continue to be the war-effort pacemaker.



COLD LIGHTNING

Up on the edge of the Arctic, Allied pilots are wearing electrical heated flying suits. But there's no such protection for their hi flying P-38s. At 30,000 feet the cold reaches 67° below zero. sea level the cold is still intense. Yet normal operation of t plane's hydraulic controls is absolutely necessary even at su temperatures. VARD makes hydraulic control valves and actuati units for the Lockheed Lightning. Some of these are built to c own design, others originated with the aircraft company. VA precision-built hydraulics are doing the job well, and no mat how bitter the cold, the P-38 is always—Lightning!

VARD INC
PASADENA, CALIFORNIA, U.S.

The Challenge of the Present... and the Promise of the Future!

THESE are challenging days in which to live and work—and America has met the challenge. Week by week, the people of this country are proving that they can make sacrifices and ignore discomforts. And industry has met the challenge by pooling its knowledge and resources, developing new techniques and materials, and creating a vast new reservoir of supply.

The result of all this is a great new market of the future. A growing demand for millions of war-restricted articles—new, improved products for post-war competition—a backlog of savings created by war bonds and curtailed buying. . . . The result, say many of America's foremost analysts, is *post-war prosperity!*

If you are to be prepared for a quick transition from armament to peacetime business, *now* is the time to study your tooling problems—and in this we can help you. For Bryant engineers are among the foremost authorities in the specialized field of internal grinding . . . and today, with their major war production problems solved, they are once more ready to help you.

Write now and give them full information on your internal grinding problems.

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Springfield, Vermont, U. S. A.





John Hall

United Aircraft Corporation announces that RAYCROFT WALSH has been designated senior vice president and J. REED MILLER elected a vice president of the corporation. Mr. Walsh has been with United since 1930 when he was elected vice president and director of Hamilton Standard Propeller, which position he left in 1940 to become vice president of United. Mr. Miller has been with United since 1924 when he joined Hamilton's predecessor, Standard Steel Propeller. He continues as a vice-president and director of Pratt & Whitney and general manager of United.



U. S. A. F.

MAJOR RICHARD T. KIGHT, pilot of the transport plane which carried Wendell Willkie on his 28,000 mile around-the-world flight, was awarded an oak leaf cluster for the Distinguished Flying Cross for extraordinary achievement in completing a difficult and hazardous mission.



C. B. "SCOTTY" ALLISON formerly chief pilot for Generalissimo Chiang Kai-shek, and later a member of the U. S. Ferry Command, is now a member of the B. F. Goodrich Company in charge of flying operations. He first soloed in 1920, then barnstormed for several years.



IGOR SIKORSKY, winner of double honors from the Institute of Aeronautical Sciences. He has been elected an honorary fellow, and also named to receive its annual Sylvanus Albert Reed Award for 1942 for a notable aeronautical contribution with apparent practical value.



DR. DONALD S. FREDERICK of Rohm & Haas was awarded the annual John Wesley Hyatt Award for an outstanding contribution in 1941 to the plastics industry. The award, established by Hercules Powder, is named for the man credited with being the inventor of the first plastic.



EDMUND T. ALLEN, one of this country's foremost test pilots and aeronautical engineers, was honored by a dinner given him by the Institute of the Aeronautical Sciences on the 39th anniversary of the first flight of the Wright brothers, for which he gave Wright Brothers Lecture.



FRED H. COLVIN, Editor Emeritus of American Machinist, was awarded the Worcester Reed Warner Medal at the annual ASME meeting for "influence toward efficiency and humanity in industry." At present, he is giving full time to the Navy as technical consultant.



DR. HUGH L. DRYDEN of the National Bureau of Standards has been elected eleventh president of the Institute of the Aeronautical Sciences for the year 1943. He is an honorary Fellow of the Institute and editor of the Institute's Journal of the Aeronautical Sciences.



CDR. EDWARD S. EVANS, president of Evans Products, was elected to the board of directors of Bowlus Sailplane. He is an advocate of gliding and soaring and donor of the Edward S. Evans trophy for future "grand gliding" championships of the United States Army.



F. C. CRAWFORD, president of Thompson Products, was elected president of NAM for the coming year by the new board of directors, succeeding W. P. Witherow, now chairman of the board. Mr. Crawford was chairman of the War Congress Reconstruction Committee.



ALFRED MARCHEV, Republic vice-president, has been named gen. mgr. of the company's L. I. plant. He joined Republic in 1942 as asst. to the president, later became vice-president and asst. gen. mgr. Ralph Damon has relinquished the post to supervise other plants.



CAPTAIN BASIL ROWE of Pan American Airways has just celebrated the completion of 26 years of continuous flying. He has rolled up a total of 18,890 hours of flying time which Pan American figures mean 9 years of working days in the sky.



LOUIS R. INWOOD, for the past two years with the War Production Board and its predecessors, where he assisted in planning distribution of materials for aircraft producers, has joined the staff of Transcontinental & Western Air as assistant to the treasurer and RUSSELL CANTWELL joins them as executive assistant to E. Lee Talman, vice-pres. & treas. For the past two years he has been aviation commissioner of the Kansas City, Mo., Chamber of Commerce where he was primarily responsible for planning Missouri's broad aviation program.



Recent Books

AEROSPHERE 1942, *edited by Glenn D. Angle. Published by Aircraft Publications, New York. 1165 pages. $12.50.*

A massive, arm-breaking catalog of the transport, trainer, and fighter planes of 22 nations, including specifications, construction, standard equipment, instruments, and revealed performance. There are also chapters on engines, statistics (mostly U.S.) and a buyer's guide.

Since last year's edition, sections on American, Russian, and Jap planes have been expanded. And added are a special chapter on armament and its future, also statements by leading American military aviation officers.

Says Maj. Gen. George E. Stratemeyer, chief of the Army air staff: "Our planes have a battle record of approximately two enemy planes destroyed for each Air Forces fighter or bomber shot down in aerial combat."

But in an introductory article titled, Airpower in Action, Cy Caldwell points out: "There is no certainty that the present advantage enjoyed by the RAF and the small American force will continue forever. There is not yet in the world a great airpower nation—a nation that can gain control of the air as Britain and the United States earlier gained control of the seas."

WHAT'S THAT PLANE? *by Walter Fitzkin, Jr. Published by Penguin Books, Inc. New York, and The Infantry Journal, Inc., Washington. 222 pages, appendix, illustrations, index. 25c.*

With the addition of 19 planes, mostly American, data on which were not available last spring, the second edition of this book contains short descriptions on speed, range, altitude, armor, and power of 83 British, American, and Jap fighter, bomber, and transport planes and German long-range ocean planes.

Data is introduced by a brief chapter on methods of identification, with classification according to visual characteristics which are illustrated by plane, front, and side view silhouettes, many of them taken from AVIATION.

HURRICANES, *by Ivan Ray Tannehill. Published by Princeton University Press, Princeton. 265 pages, illustrations, appendix, bibliography. $3.50.*

Whys and wherefores—but, alas, not the prevention—of hurricanes are now laid bare by the chief of the Marine Division, U. S. Weather Bureau.

In simple language and with references to official and personal records, he analyzes the origin, tracks, winds, accompanying rainfalls, and results of hurricanes. They have destroyed and saved. They have filled reservoirs and, in March, 1889, perhaps prevented a war between the United States and Germany by wrecking six naval vessels about to "pot" each other in Samoa.

But lest these good deeds belie their true temper, Mr. Tannehill includes a chronology (with estimates of damage) of hurricanes from June 16, 1494, onward and a few notes (in an appendix prepared for this second edition) on the 1938 wind which "caused greater economic loss than any other single storm in the world's history."

INTRODUCTION TO AIRCRAFT DESIGN, *by Thomas P. Faulconer. Published by McGraw-Hill Book Co., New York. 273 pages, illustrations, appendix, index. $2.75.*

Here is material based upon lectures given by the University of California to prepare engineers from other fields for technical positions in the aircraft industry.

The various subjects discussed fall roughly into three parts: (1) Basic design (wing, fuselage, and hull structures, landing gears, materials, and stress and weight analyses), (2) military aircraft (performance, engines, control surfaces, hydraulics, and fixed and electrical equipment); (3) contracts and testing.

Aside from one equation-packed chapter on aerodynamics, this is a simple description of how and with what a plane is developed. "The aim," says Mr. Faulconer, "has been to provide the additional amount of information to fit the man with general training and background into the specialist's job."

WINGS OVER AMERICA, *by Harry Bruno. Published by Robert M. McBride & Co., New York. 333 pages, illustrations, index. $3.*

Seventeen-year-old Harry Bruno took his first flight on Dec. 26, 1910, off the icy edge of a 60-ft. cliff in a glider he and a friend had constructed. Bruno has been in the air, or near it, ever since and drawing upon the experience of those 32 years, he has now sat down reminiscences and enough additional facts to make a fascinating, well-written resumé of American aviation progress.

Bruno learned piloting from nimble-footed Vernon Castle. After the World War I, when the greatest danger in aviation was starving to death, he took a publicity job with Aeromarine Airways. He (and his partner, the late Dick Blythe) then handled publicity for nearly all the big names in aviation since then—Wright Aeronautical, Lindbergh, Post and Gatty, American Airlines, Pan American, Transcontinental Air Transport, et al. These contacts fill his book with a lively mixture of experience and personal opinion.

Among his beliefs: That the *Hindenburg* was sabotaged . . . that Byrd's unhappy trans-Atlantic flight first "proved that even weather was no obstacle to a successful ocean crossing" . . . that Lindbergh lost his popularity because he "always understood machines better than people."

If Bruno's predictions are as good as Billy Mitchell's, future air transport will see multi-decked planes with 10,000-hp. electric motors drawing power by waves from ground stations and mama, papa, and junior will be flitting about in helicopters.

As though to make such visions reasonable, Bruno has appended 64 pages of pictures of aviation progress. Obviously there's been plenty in aviation's first 39 years.

FLIGHT INSTRUCTOR, *by Charles A. Zweng. Published by Pan American Navigation Service, North Hollywood, Calif. 480 pages, illustrations, index, $4.*

On the premise that "the student's performance is a direct reflection of the instructor's technique and ability," a former Army Air Corps instructor has prepared this manual "to teach pilots to teach."

Simply and briefly, he organizes the knowledge which aspiring instructors learned during their own progress to pilothood into definite suggestions and lessons to be taught fledglings. Following the curriculum recommended by the CAA, this book includes notes on theory, technique, and preliminary instruction, extensive chapters on cross-country flying, elementary, intermediate, and advanced maneuvers, regulations, and typical pilot's and instructor's examination questions.

PROCESS PRACTICES IN THE AIRCRAFT INDUSTRY, *by Frank D. Klein, Jr. Published by McGraw-Hill Book Co., New York. 266 pages, illustrations, index, $2.75.*

This is a detailed reference and instruction book for skilled aircraft labor detailing procurement, properties, and processing of materials into finished parts meeting government standards.

The author, senior metallurgist, Materials Control Branch, Army Air Forces, treats the assembling process chronologically from the procurement and characteristics of finishes, fabrics, and metals through their preparation and fastening, finishing, and inspection.



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Booth "prescription" felt...precision-cut into mechanical parts . . . is being used successfully in "unbelievable" applications.

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He has also generously sprinkled the text with production directions and tables on properties and performances. For instance, the 22-page chapter on magnesium contains tables on the physical constants and chemical resistance of pure and alloyed magnesium, plus formulas and instructions for chemical surface treatments.

ELEMENTARY METEOROLOGY, *by Vernon C. Finch, Glenn T. Trewartha, M. H. Shearer and Frederick L. Caudle. Published by McGraw-Hill Book Co., New York. 301 pages, illustrations, appendices, index, $1.76.*

Offers simply written explanation, for secondary school students, of the nature and effect of weather and its importance to flying. Questions, suggested activities, topics for class reports, and summaries follow each chapter, and there are appendices on the seasons, instruments, and the interpretation of weather maps.

WORKBOOK IN METEOROLOGY, *by Athelstan F. Spilhaus and James E. Miller. Published by McGraw-Hill Book Co., New York. 163 pages, appendix, index, paper bound, $2.50.*

A ringbound notebook containing brief explanations of elementary phases of meteorology. Mean condition of the atmosphere, instruments, and methods of observation, dynamical meteorology, and weather map and upper-air analyses. Each subdivision of these sections is followed by references to standard texts, charts, and maps, and there are exercise sheets to be filled in by the student.

WEATHER STUDY, *by David Brunt. Published by The Ronald Press Co., New York. 215 pages, appendix, index, $2.25.*

Detailed and comprehensive mathematical introduction to meteorology for student flyers.

MERRIMAN'S STRENGTH OF MATERIALS, *eighth edition revised by Edward K. Hankin. Published by John Wiley & Sons, New York. 148 pages, tables, diagrams, index, $1.50.*

For secondary school students and mechanics, this is a simplified, elementary text with numerous review problems, also an appendix on the general properties of modern industrial materials.

MAP READING AND AVIGATION, *by Richard M. Field and Harlan T. Stetson. Published by D. Van Nostrand Co., New York. 129 pages, illustrations, appendix, index, $2.50.*

Requiring only a knowledge of elementary algebra and plane geometry, this text is designed to familiarize would-be pilots with primary principles of locating themselves. From it they can learn interpretation of aerial photos and contour maps, the principles of celestial navigation, also use of the *Air Almanac* and H. O. 214 tables, excerpts from which are contained in the appendix.

SIMPLIFIED INDUSTRIAL MATHEMATICS, *by John H. Wolfe, William F. Mueller, and Seibert D. Milliken. Published by McGraw-Hill Book Co., New York. 291 pages, tables, index, $2.*

Mathematics of fractions, gears, threads, precision instruments, and trigonometry simply outlined, and including questions, for those apprentice mechanics who direct their fingers with figures.

MECHANICAL PHYSICS, *by Herbert Dingle. Published by the Ronald Press Co., New York. 248 pages, index, $2.25.*

Principles of physics are explained here for undergraduates in terms applicable to aeronautics. Physical measurements, properties of matter, heat, vibrations, and sound—the general topics—are considered.

MODERN TRIGONOMETRY, *by M. J. G. Hearley. Published by The Ronald Press Co., New York. 168 pages, tables, $1.75.*

Numerical aspects of trig, including sections on astronomy, mechanics, and air navigation, for students familiar with arithmetic and elementary algebra.

ESSENTIAL MATHEMATICS FOR SKILLED WORKERS, *by Harry M. Kaal and Clarence J. Leonard. Published by John Wiley & Sons, New York. 293 pages, index, $1.50.*

Simple summary dealing with algebra, geometry, graphs, logarithms, oblique triangles, use of the slide rule and including problems, for high school students and shop workers in the various fields.

HEROINES OF THE SKY, *by Jean Adams and Margaret Kimball in collaboration with Jeanette Eaton. Published by Doubleday, Doran & Co., New York. 295 pages, illustrated, $2.50.*

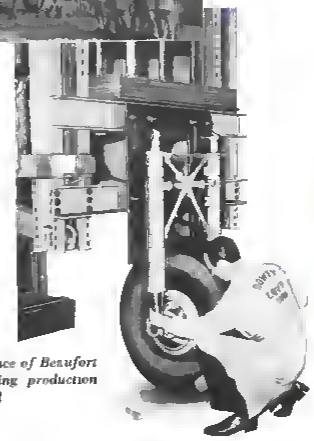
Women's achievements in American aviation are related herein through brief biographies of the flying careers of females, some famous and some who are now only dimly remembered.

From Aug. 2, 1911, the day Harriet Quimby became the United States' first licensed woman pilot, to the recent appointment of Nancy Harkness Love to head the Women's Auxiliary Ferrying Squadron, women's rise in aviation has been a "valiant conquest of handicaps. For flying has not been made easy for women."





R.A.F. personnel inspect squadron of Beauforts.



Checking performance of Beaufort strut assembly during production drop test under load

Licking complex engineering and manufacturing problems is a habit with us . . . evidenced by the prompt completion of a difficult contract for our friends "down under," and the ability to take in our stride an emergency reorder. Again, this proves that our versatility, born of wide experience, plus a flexible method of sub-contract operation makes Dowty a good name to keep in mind when confronted with landing gear or hydraulic pump problems.

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PRELUDE TO AN AIR OFFENSIVE

HISTORY-MAKING air offensives begin on the ground—in drafting rooms and on assembly lines like those at Fleetwings' "*attack*" plants.

Here, pioneering engineers and Victory-minded employees are busy designing and building the myriad parts that go into the 'planes of America's air-armada.

Working with stainless steel, with aluminum, with bonded plywoods, they are turning out various types of complete 'planes. They are also serving others by supplying wings, fins, rudders, ailerons, stabilizers, fuselage sections, hydraulic equipment, and other parts.

Realizing, too, that America's air-offensive must never cease, but merely be turned into peace-time channels, Fleetwings already is planning for the change-over. Present plans promise that noteworthy aircraft developments by Fleetwings will continue for a long time to come.

★

FLEETWINGS

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FLEETWINGS

pioneers with parts and hydraulic equipment



The BT-12, all-welded basic trainer built for the U. S. Army Air Forces

STURDY, MANEUVERABLE, *air-worthy!* That best describes the Fleetwings trainer, the *first* all-welded military 'plane constructed principally of stainless steel. The BT-12 will be "*air-ancestor*" to many bigger and faster 'planes yet unborn.

MANY MEN IN AIRCRAFT know of Fleetwings' ability to "do the impossible" with stainless steel. Not so many know that Fleetwings is also experienced in other alloys, in aluminum, *and even in plywood!* This experience has been both as a prime and as a sub-contractor in producing large-scale quantities.

WOMEN AIRCRAFT ENGINEERS. Women were recently added to Fleetwings' engineering staff—the first in their department. And just as women on Fleetwings' assembly lines have proved there is no "weaker sex," these women engineers are proving that they can contribute vitally to the increasing output of the Fleetwings engineering department.

INFORMATION ABOUT production shortcuts and unusual aircraft developments at Fleetwings is told in a monthly magazine known as "The Fleetwings' Arrow." If you'd like to get a copy of this magazine regularly, merely write us on your company letterhead and tell us so. Send your request to "The Arrow," Fleetwings, Inc., Bristol, Pa. Of course, there's no charge.



"KEEP 'EM FLYING!"

FLEETWINGS

Incorporated

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Americe At Wer

(*Continued from page* 91)

This year brings the "end of the beginning," as Churchill called it. In Asia the Japs have been defeated in several battles, but no military authority has ventured to see any general faltering as yet. It seems clear they haven't got what it takes to overrun Australia or New Guinea, or even any more of the Solomons. Their aviation shows determination and skill, but their quality and their numbers do not seem to gain. People who know from watching them in their own factories say that the job of retooling (many of their machine tools are imported) and turning out new fighters and bombers, will work a hardship on them.

They seriously need a completely redesigned fighter, for one thing. Their *Zero*, with its hairpin-turn ability and mountain-goat climb, is no match for the heavy, fast, big-gunned American plane it has to combat.

The Japanese, in their thousands of islands, mined passages, and jungle trees, have spread far and wide and will be hard to squeeze back into their narrow slot. Nevertheless, their shipping is stretched out like a web to be torn to pieces. Secretary Knox says Nipponese war and merchant shipbuilding is now barely able to keep up with the toll our submarines and planes are taking.

But you can't trust signs of weakness in determined fighters like the Japs and the Germans. Even ten counts is not enough. In this ring, you don't let up on your man until he is in the morgue.

Lockkeed P-38 Has Wide Uses

(*Continued from page* 101)

cruising speed. Either gas tanks or bombs may be hung from the same racks, so that one bomb and one extra tank may be carried if the mission requires, or this extra weight-carrying ability may be utilized for carrying tanks for laying smoke screens, to accommodate equipment for ground troops, or for some other purpose.

Armament consists of four heavy-calibre machine guns and one cannon mounted in the nose and firing between the propeller arcs, thus eliminating the cone of fire encountered when guns are mounted in the wings. Conforming to standard American practice, the pilot and vital parts of the plane are protected by armor plate, and the plane is equipped with self-sealing fuel tanks.

The wing has no ribs, being of double-skinned, double-stressed design.

In combat operation, the P-38 has been found to possess unusual flying ability on one engine. In Coral Sea engagements, for example, a P-38 on a photographic mission with one engine disabled was able to outclimb three different groups of Jap *Zeros*. In another engagement in the Aleutians, a pilot flew a P-38 150 mi. back to his base with one engine shot away.

Specifications released to date include:

Wing span	52 ft
Length	38 ft
Height	9 ft.
Wing loading	48 lb. sq. ft.
Gross wt.	13,500 lb.
Maximum speed	Above 400 mph
Landing speed	80 mph
Power plant	Two 1150 hp. Allisons
Propellers	Turbine driven constant speed electric, 11½ ft. arc

Investment Status of Industry

(*Continued from page* 96)

loans, guaranteed by the Federal Reserve. However, the commercial banks, which were eagerly anticipating this type of business, soon discovered that these loans failed to materialize to any appreciable extent.

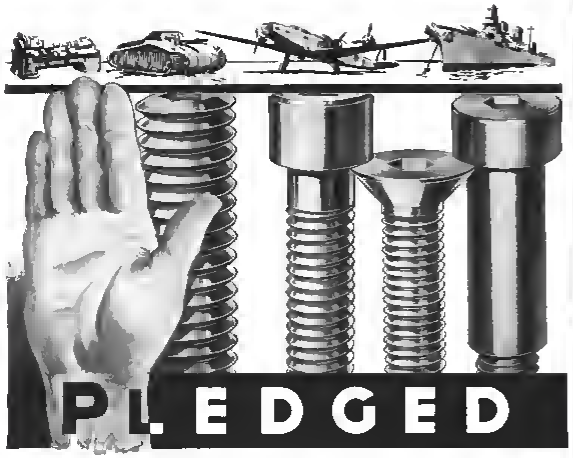
While publicity was given the $1,000,000,000 line of credit arranged by General Motors, but less well known is the fact that thus far only $50,000,000, or 5 percent of the total, has been drawn against this credit. While sizeable banking lines are currently being arranged for Bendix and Borg Warner, the actual borrowings by these and other aircraft companies is not expected to bulk very large. This is the face of mounting production.

Answer to this phenomenon lies in the "progress payments" received on government war work. These "progress payments" permit the aircraft manufacturers to replenish their cash resources at a much faster rate than was formerly believed possible. This in itself is a tribute to better aircraft management along with smoother coordination with government agencies.

It is unlikely that working capital limitations will be a restrictive influence on aircraft production. WPB Chairman Nelson estimated 1942 production of planes at about 49,000, which fell short of the original goal of 60,000 set by the President. However, material and parts shortages were primarily responsible for keeping output within last year's total. It must also be recognized that many of the planes were of the heavier type. Measured in weight, 1942 production was highly creditable.

The shape of things to come was clearly indicated when Mr. Nelson predicted that aircraft will be a 30 to 40 billion dollar industry within a year. This volume of business is a cogent reminder that the aircraft industry has a mission to perform and it will be ac-

(*Turn to page* 310)



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Whether of machine tools, tanks, planes or ships, "Allens" preserve the UNITY of each assembly. They hold parts together *under fire!* They support the quality of *your* war goods by maintaining their own.

Our speed has been upped in all operations; time has been cut without cutting *essentials.* Shortages of critical materials have been met without impairing the standard of STRENGTH you've identified with these hollow screws.

Thirty-two years of product-integrity are Allen's pledge that Quality *will be* upheld. The record is promise of quality *more* than held, — continually to be improved. The Allen Manufacturing Company, Hartford, Connecticut.

Order only through your local Allen Distributor — the man who gets you the goods to the LIMIT of the supply!

ALLENS

complished before any postwar fears will be allowed to interfere.

Capacity production scheduled for the near-term and the unknowns of the future are highly confusing to anyone attempting to ascertain if aircraft common stocks are investments. There is always that question about the risks harbored by aircraft equities.

No one can avoid the conclusion that common stocks of aircraft manufacturing companies contain risks. They harbor risks primarily because they are common stocks, and common stocks harbor risks since they afford participation in the perils as well as the profits of business enterprise. Aircraft company equities, moreover, carry the type of risk resident in equities of enterprises engaged in infant industries, the future for which is virtually incalculable.

But from this conclusion it's a long jump to the decision that aircraft manufacturing company common stocks should be avoided by conservative minded investors. The epic of this country's industrial growth argues strongly to the contrary. If such equities must be avoided simply because they harbor risks, then all risk-laden securities must be avoided. And if all risk-laden securities should be avoided, investors' plight in selection of media for their savings would be a sorry one.

Further, the industrial development of the country has been greatly fostered by those willing to assume certain basic risks.

Risks are present everywhere. They reside in the investment portfolio composed exclusively of high quality bonds —especially when inflation threatens to impair purchasing power of dollars derived from fixed-income securities.

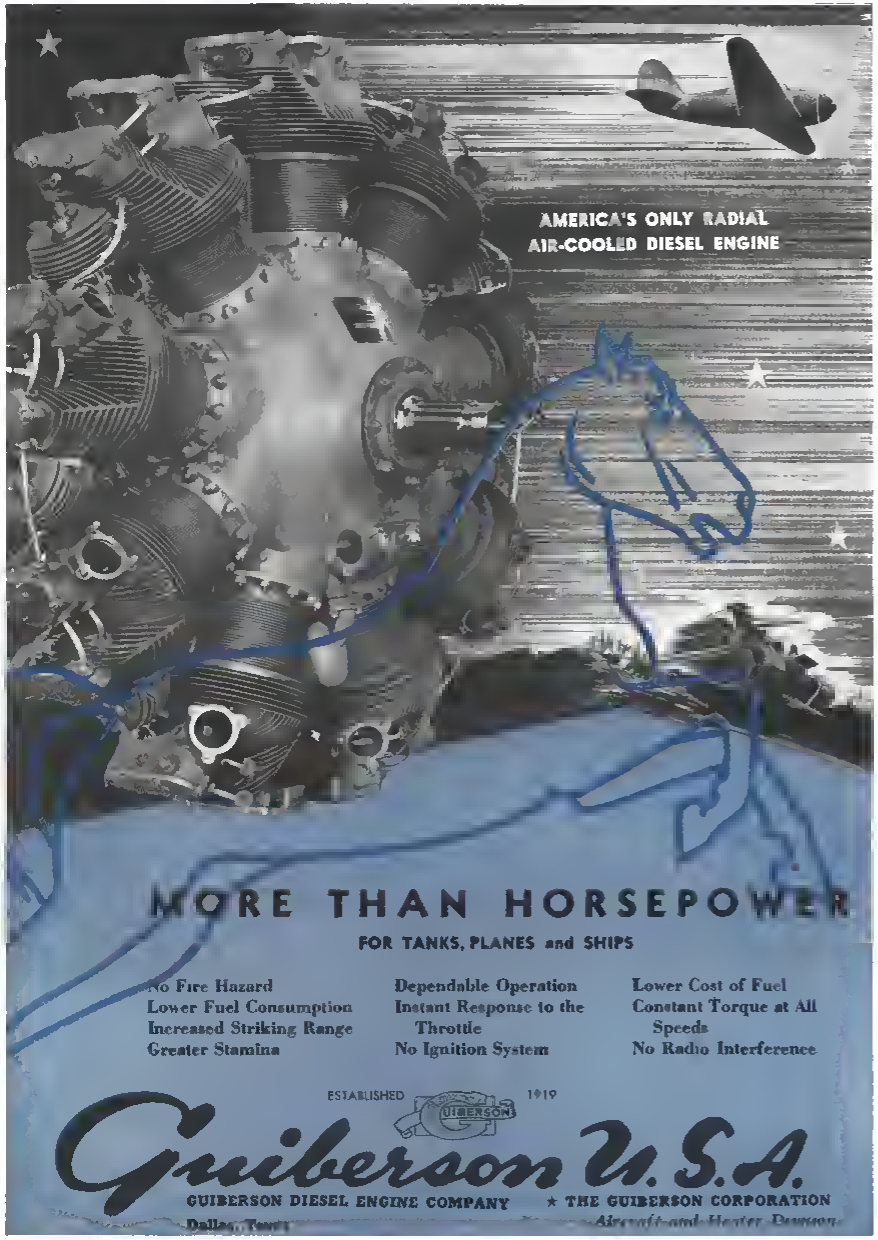
One authority notes: "It is because of the presence of risk that sirens are placed on locomotives, horns on automobiles, signal lights on street crossings, life belts on steamships, and parachutes on airplanes. Insecurity is the law of life."

Returning to the question of aircraft equities, it is not enough to determine whether such issues harbor risks. Main problem is to determine whether compensation for such risks is afforded in immediate dividend income, in growth possibilities, or both.

When this measure is applied to the common stocks of the sounder aircraft companies—particularly those which have pioneered in the industry's growth and who have good technical and research staffs—it is difficult to escape the conclusion that such aircraft issues can prudently be included in moderate amounts in investment portfolios affording adequate representation in high quality securities.

HERE'S A PAGE FROM AERO TOOL'S NEW 44-PAGE CATALOG
COPY SENT ON REQUEST (ON YOUR FIRM LETTERHEAD, PLEASE)





Takeoffs and Landings

(Continued from page 95)

values is limited between zero lift and the lift in the full tail-down attitude. Flaps may be taken into consideration by simply substituting the proper values in equation 9. The optimum value of C_L may be determined by selecting the value of surface friction coefficient to be used, setting it equal to $\frac{C_L}{\pi AR_e}$ and arranging as follows: $C_L = \mu_f \pi AR_e$. The angle of trim corresponding to the given C_L value may be determined.

That there is any advantage in finding the value of C_L for minimum takeoff distance for every value of μ is rather doubtful, because it is impractical for the pilot to maintain a given angle of trim during the ground run.

Ground Effect

Before drawing any further conclusions as to optimum attitude for takeoff, ground effect must be taken into consideration. However, it is rather difficult to allow, directly, for ground effect in the basic force summation equations, therefore the influence of ground effect has here been generalized, with a corrective factor added.

Although the analysis revealed that every airplane would have slightly different critical values of rolling-friction coefficient, it seems safe to generalize that a three point takeoff will yield the shortest ground run on most commonly-used surfaces, except very smooth concrete runways. Further, the shortest landing may be effected by touching down three point, then continuing the roll in a tail-high attitude, applying as much brake as possible without skidding the tires or overturning the airplane.

Proximity of the wing to the ground causes a reduction, both of the downwash angle and the induced angle of flow in front of the wing. This action is similar to that which would be produced by an imaginary wing, identical to the real wing, but inverted, flying directly beneath the actual wing, and twice as far from the real wing as the ground is from the real wing. Per Prof. E. G. Reid*—

"A velocity and force diagram for the real wing is given in Fig. 2. The self induced vertical velocity is w, the mutually induced component is designated Δw, and the vector sum of these (the resultant induced vertical velocity) is w'. The inclination of the effective stream direction is thus reduced by the angle $\Delta w/U$ and induced drag is cor-

(Turn to page 315)

* Reference: Pages 166–178, "Applied Wing Theory," by Elliott L. Reid, Professor of Aeronautics, Stanford University, McGraw-Hill Book Co., 1932.







Lawrance Auxiliary Power Plant
Model 75B

THE electricity needed for auxiliary purposes by one of America's great patrol bombers or cargo transports corresponds to the normal power requirements of ten ordinary homes. Lawrance Auxiliary Power Plants, installed in bombers of the U. S. Navy, are portable powerhouses which make it possible for these huge aircraft to carry a self-contained source of vital electricity with them wherever they go. Afloat or aloft, Lawrance Power is available at the touch of a switch – power to operate galley hot plate, lights, heat, radio, gun turrets, bomb hoists and main engine starters. "Dependable Power by Lawrance" is a watchword in our fighting forces of sea and air – tried and proved in world-wide combat.

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AUXILIARY POWER

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assign the subscript 1 to quantities pertaining to the real wing and 1′ to those of the image, the total induced drag of the "biplane" would be

(a) $D_{ib} = D_{oi} + \epsilon D_{oi}' + D_i'$

Of this, the part experienced by the real wing is

(b) $D_i = D_{oi} + D_{oi}'$

And assuming the lift distribution is elliptical,

(c) $D_i = \frac{L_i^2}{\pi q b^2} + \sigma_{11}' \frac{L_i L_i'}{\pi q b_i b_i'}$

Just as in the case of the rectangular wing biplane, the variation of span loadings likely to be met in practice do not appreciably modify the mutually induced drag, therefore the accuracy obtained by using equation (c) may be considered satisfactory for common forms of monoplanes. The spans and lifts are related thus

$b_i = b_i' \qquad L_i = L_i'$

Equation (c) may therefore be written

$$D_i = \frac{L^2}{\pi q b^2}(1 - \sigma_{11}')$$

Therefore the amount the induced drag is changed by ground effect is expressed:

$$\Delta D_i = -\sigma_{11}' \frac{L^2}{\pi q b^2}$$

The value of σ may be determined from Fig. 3."

Table of Surface Coefficients	
1 Smooth concrete	10 to .02
2 Hard turf	.04
3 Avg. field, short grass	.05
4 Avg. field, long grass	.10
5 Soft sand, mud, etc.	10 to .30

Fig. 4 has been computed so that a quick evaluation can be made of ground effect upon the average airplane. Percentage reduction in D_i is based upon $0.12\ h/b$ average wing height above the ground. As seen from Fig. 4, the reduction in induced drag in this case is 40 percent. Equation 9 shows that for a given airplane, at a given speed, the value of μ_{cR} will be reduced about 40 percent if ground effect is taken into consideration.

In order to lend significance to the foregoing analysis, the value of μ_{cR} at which a tail down attitude would yield the shortest takeoff distance, will be computed. This computation is for a representative airplane of the following characteristics.

$C_D = .148 \qquad C_{DR} = .050 \qquad C_{LT} = 1.8$

10 $\mu_{cR} = \frac{C_D - C_{DR}}{C_{LT}}$

11 $\mu_{cR} = .066$

And considering ground effect

12 $\mu_{cR} = .040$

GETTING A START WITH CANNON PLUGS



The ground battery for aircraft which supplies auxiliary current for starting engines or testing radio and control devices is often connected to the plane through this Cannon Connector. By this means the batteries on the plane are relieved of the extra load of starting cold motors and their charge may be saved for the necessary functions while in flight.

A small third terminal shown in these fittings is used to operate a signaling device so that the pilot may know when the ground battery has been disconnected.

This is only one of thousands of specialized electrical connectors built by Cannon for aircraft. All are precision built and embody many features that aid the men who use them. They are all backed by more than a quarter century of experience in the electrical specialty business.



Pony Express Battery Cart, manufactured by Rocky Mountain Steel Products Company, Los Angeles, features 12 and 24 volt service handled through 2 sets of cables. Los go plugs with 4 contacts are special Cannon Type M-1 Connectors.

CANNON SERVES MANY INDUSTRIES

The aircraft industry is only one user of Cannon Plugs. They are standard equipment in radio, television, sound studios and theatres. They are used in geophysical research, railroad rolling stock and in countless fields where dependable connections are needed.

CANNON ELECTRIC

Cannon Electric Development Company, Los Angeles, California

Canadian Factory and Engineering Office:
Cannon Electric Company, Ltd., Toronto, Canada



MORE THAN
3,827,500 A DAY
-and it's not enough!

EVERY single day almost four million Elastic Stop Nuts go into war production.

Even at that, and with all our expanded plant, it doesn't fill the demand.

It happens that the most urgent need right now is on aircraft. Every American plane that takes the air has some important part of its structure fastened with these strong, tight-holding nuts. Some types take as many as 35,000 in a single ship.

The reason is: *these nuts stay put under the toughest circumstances.*

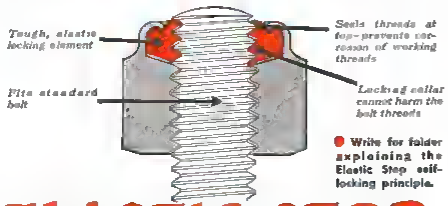
You handle them exactly like regular nuts. They go on fast, lock immediately and automatically.

There's no need of pins, washers or auxiliary locking devices.

Once on, they stay there—never shake loose. But you can take them off and put them back on many times and they won't lose their locking ability.

This is why there are more Elastic Stop Nuts on America's planes than all other lock nuts combined. And why they are also used in important structural applications on guns, naval vessels and other war equipment.

We have made billions of Elastic Stop Nuts and, as far as we know, not one has ever loosened.



● Write for folder explaining the Elastic Stop self-locking principle.

ELASTIC STOP

SELF-LOCKING NUTS AND AIRCRAFT FITTINGS

ELASTIC STOP NUT CORPORATION
2330 Vauxhall Rd., Union, N. J.

Loading Attitude for Minimum Roll

Problem of finding a landing attitude for shortest landing roll may be treated in the same manner as the problem of finding takeoff attitude for minimum takeoff distance. A summation of the horizontal forces acting upon an airplane during a tail high, zero lift, landing roll is:

13. $\Sigma F_x = Ma - (C_{xr}Sq + \mu' W) = 0$

Rewriting and solving for rolling distance:

14. $\frac{W}{g} V \frac{dV}{dX} = C_{xr}Sq + \mu' W$

15. $X = \int_{t_L} \frac{WVdV}{g[C_{xr}Sq + \mu' W]}$

Case of the three point landing roll may be considered in the same manner as above, except that the effect of lift on induced drag rolling and braking forces must be taken in consideration. Summation of horizontal forces now becomes:

16. $\Sigma F = Ma - [C_{xs}Sq + \mu'(W - C_{LS}q)] = 0$

Rewriting and solving for rolling distance:

17. $\frac{W}{g} V \frac{dV}{dX} = [C_{xs}Sq + \mu (W - C_{LS}q)]$

18. $X = \int_{V_L} \frac{WVdV}{g[C_{xs}Sq + \mu'(W - C_{LS}q)]}$

Comparison of equations 15 and 18 for a given airplane under identical conditions of weight and speed, will reveal that the term $(C_{xr}Sq + \mu' W)$ in equation 15 and $[(C_{xs}Sq + \mu'(W - C_{LS}q)]$ in equation 18 will determine the landing distance. By equating these two terms, as was done in the previous section, the critical value of μ'_{cr} may be determined.

19. $C_{xr}Sq + \mu' W = C_{xs}Sq + \mu' W - \mu' C_{LS}Sq$

20. $\mu'_{cr} = \frac{C_{xs} - C_{xr}}{C_{LS}}$

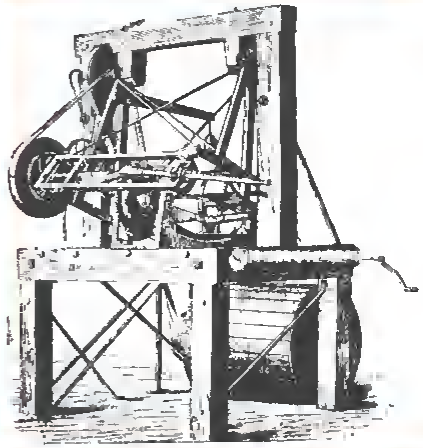
Since the landing distance is inversely proportional to the denominators in equations 15 and 18, it is desirable to have these values as large as possible. And since μ' (the braking friction coefficient) is quite high, it is evident that the tail high attitude will yield a shorter landing roll than the airplane rolling in the three point position, if both landings are made at the same speed. It is also obvious that any decrease in the landing speed will further reduce the tail-high rolling distance.

In view of the above analysis, and in view of the fact that ground effect will reduce the critical value of μ'_{cr} 40 percent, it is recommended that a three point landing be made (low speed), followed by a tail-high roll in which full use of the brakes is made.

(*Turn to page 319*)

A Curious Machine

has lately been advertised that will churn, scrape Potatoes, rock the cradle and Darn Stockings



THIS bit of early-American humor, which appeared in a New England newspaper more than a century ago, may well have been inspired by the "curious machine" shown here. It marks the beginning of a public awareness of the mechanical wonders ahead . . . Back in the days when "Industry" was spelled with an "i", it was the birth notice of the Machine Age in America.

Picture the times when that notice appeared: Witchcraft was still a subject for serious dispute, and sane men believed that insanity was caused by Devils. Cocked hats and big-buckled shoes were still to be seen, and sober men declared the steam engine a passing idea, over their tankards of flip in the taverns . . . The hammer and anvil were the symbol of the times, and every part of every musket or cannon or clock was made individually, by hand.

That was the setting. And in the midst of it, some of the greatest inventive geniuses the world has ever known were quietly changing the shape of things and of thought with the "curious machines" they were inventing. Such curious machines as the one shown here. Machine *tools*, with which each part could be made in quantity, and precisely alike. . . . Tools that were to make machines that would churn, scrape potatoes, rock the cradles of industry, and even darn stockings!

* * * *

BUT they were doing more of importance than inventing curious machines. Those men of mechanical genius were founding a handful of machine tool companies that have literally made possible all the rest of industry.

One of those companies — Jones & Lamson — is here today, a direct descendant of the first great machine tool builders in America. With a heritage of skills, knowledge and equipment that has constantly grown, from the very birth of our industrial age, Jones & Lamson engineers and service men are particularly qualified to serve any phase of industry today and during the difficult period of post-war readjustment ahead.

Jones & Lamson service is at *your* service now!

J&L

JONES & LAMSON
MACHINE COMPANY
SPRINGFIELD, VERMONT, U. S. A.

Manufacturers of Ram & Saddle Type Universal Turret Lathes . . . Key Automatic Lathes . . . Automatic Thread Grinding Machines . . . Comparators . . . Automatic Opening Threading Dies and Chasers.

Profit Producing Machine Tools

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FOR 1943

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Data on new systems of Tuf-On Finishes and schedules is now available. They meet government aeronautical specifications so approval for their use may be obtained. Send for a copy.

Send for TUF-ON Systems and Schedules



TUF-ON
PLYWOOD FINISHES

Industrial Research Division of Wipe-On Corporation, 105 Hudson Street, New York City

Any use that could be made of cowl flaps and wing flaps to increase the profile and parasite drag would help decrease the landing distance, especially in the case of airplanes which have relatively high landing speeds.

Value of μ'_{cs} for a landing roll is computed for a representative airplane in order to clarify the foregoing conclusions. The airplane considered is assumed to have the following characteristics

$$C_l = 1.70 \qquad C_{DP} = .030 \qquad C_{LL} = 2.0$$

Critical value of μ'_{cs} is

$$21.\ \mu'_{cs} = \frac{1.70 - .030}{2.0} = .070$$

Since the average value of μ' for many airplanes is .35, it is concluded that the shortest landing roll can be made tail high and can be carried through zero lift into negative lift, provided adequate caution against nosing over is observed.

Conclusions

1. Attitude for minimum takeoff distance for a given field or runway surface may be determined from equation 9. In most cases it is safe to recommend that the takeoff be made tail down on fields rougher than hard turf.

2. Minimum landing roll is obtained when the landing is made three point and the roll continued in a tail-high attitude, applying the brakes as much as possible without skidding the tires or overturning the airplane. This type of landing should be regarded as an emergency maneuver only.

Labor Standards

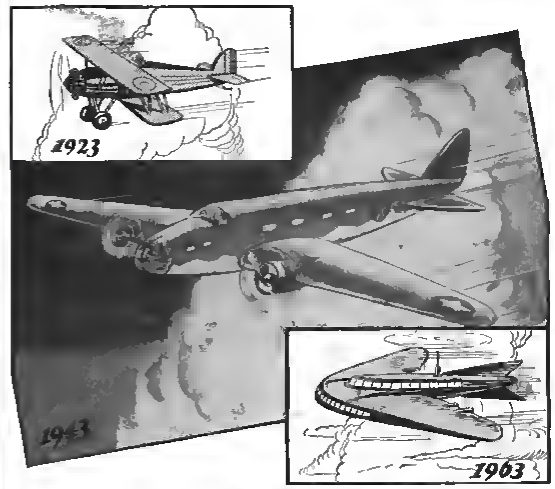
(*Continued from page 127*)

example a concern buying propellers to equip the airplanes it furnished the government would not be required to see to it that the propellers were manufactured in accordance with the provisions of the Walsh-Healey Act.

This does not mean, however, that a contractor may avoid compliance with the Act merely by shifting the work to a substitute manufacturer. In cases where the contractor turns over to another work which he would normally perform in his own plant, the contractor is liable for any violations of the Walsh-Healey Act which occur while the subcontractor is preparing materials that are used to fulfill the government contract.

Nothing in the Walsh-Healey Act prevents any person from meeting his government contract out of stock on hand if manufactured before the contract was let. Thus it does not apply retroactively. The Act does apply, however, to employees who do further work on such material either in processing

YESTERDAY... Today ...TOMORROW



FASTER - POSITIVE CLEANING RESULTS, NOW ASSURED BY MACDERMID'S TWENTY YEARS SERVICE TO INDUSTRY!

Shortly after the last war, when "cure all" cleaning methods were still the accepted procedure, MacDermid chemists working with airplane manufacturers realized the need for faster, more positive chemicals and compounds especially formulated for the different metals and cleaning problems of their industry. Through concentrated, persistent effort they have now perfected, and had approved, chemicals and compounds that are recognized by leading aircraft manufacturers as the most reliable cleaners for their present problems. As new problems arise they, too, will be answered.



TRY THESE TESTED and APPROVED COMPOUNDS IN YOUR FACTORY!

A MacDermid service engineer will be pleased to help you with your cleaning problems—show you how to get a chemically and metallurgically clean basis metal with less trouble, time, and cost.

ANODEX FOR STEEL - METEX FOR ALLOYS

PERFECTED BY THE ORIGINATORS OF THE ANODEX REVERSE CURRENT PROCESS

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Los Angeles, St. Louis, Toronto, Canada — SALES AND SERVICE FROM COAST TO COAST — Cleveland, Detroit, Chicago, Newark, New York, Philadelphia



or packing and shipping the goods *after* a contract is awarded

Both the Wage and Hour Law and the Walsh-Healey Act contain certain exemptions and exceptions. Section 13(a)(1) of the Fair Labor Standards Act exempts from the minimum wage and overtime provisions any person employed in an "executive, administrative, professional, or local retailing capacity or outside salesman," as these terms are defined and delimited in Title 29, Chapter V, Code of Federal Regulations, Part 541.[2]

Without discussing all of the requirements for exemption in these categories, it may be said that executive employees must be paid a salary of at least $30 a week to qualify for exemption. And for administrative and professional employees, the salary test is $200 monthly, except in the case of lawyers and physicians, for whom there is no salary requirement. It should be emphasized that in *addition* to the salary requirements, the duties of these employees must coincide fully with the official definition given in the regulations

An amendment to the Wage Hour definition of an administrative employee, effective Jan 17, 1942, includes within the exemption any person who receives a fee or salary of at least $200 monthly *and* "who is engaged in transporting goods or passengers for hire and who performs, under only general supervision, responsible outside work of a specialized or technical nature requiring special training, experience, or knowledge and whose duties require the exercise of discretion and independent judgment." Airplane pilots engaged in making plane deliveries would come within this exemption

In general, the Walsh-Healey Act does not apply to office and supervisory employees, or to certain maintenance or custodial employees. A foreman who does no manual work and has no direct physical contact with the goods furnished the government will be exempt even if he occasionally lends a hand here and there in the course of his purely supervisory duties.

Both Acts require covered employers to keep certain time and payroll records which must include the following information: Employee's name, address, occupation (and age in the case of minors), time of day and day of week on which employee's work-week begins, regular hourly rate of pay; hours worked each work day and total hours worked each workweek; total deductions

2 These regulations and other informative publications concerning the Walsh-Healey Act and Fair Labor Standards Act are available without cost at all offices of the Wage and Hour and Public Contracts Divisions, including the National Office Desk MSS 165 W 46th Street New York City

(*Turn to page* 323)

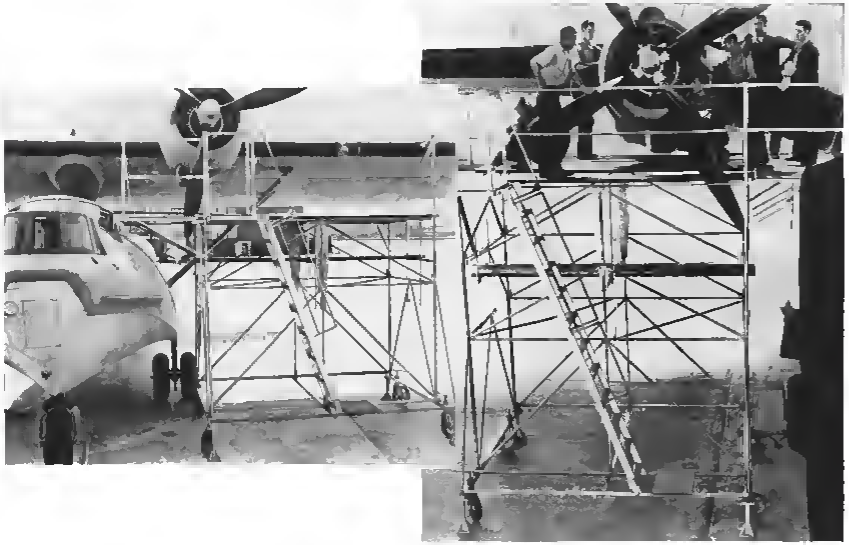


Here's a Versatile Repair Stand for the HIGH Jobs



W & M engineers first found out what was wanted by the men responsible for servicing the big ships—both military and civil, and then designed a structure around these requirements. The "Giraffe" is no experiment. Like our smaller Universal Repair Stand it is on active duty both here and abroad—on concrete floors, in deep sand and heavy mud.

The "Giraffe" is composed of three elements—a master base, a master top, and any number of intermediate 3 foot sections to produce required heights from 7 ft. to 25 ft. It is light in weight for air transportation to distant fields, quickly assembled or knocked down and all structural members are matchmarked with identifying colors and numbers. A propeller well facilitates motor maintenance . . . Oversize casters provide mobility under any ground conditions, and permanent jacks give the platform extreme rigidity when in use . . . Priorities and allocations enable us to offer prompt delivery on this versatile, **proven** repair stand . . . A letter will bring you complete data.



THE WOLFE & MANN MFG. CO.
AIRCRAFT EQUIPMENT DIVISION
28th. & SISSON STS., BALTIMORE, MD.

from or additions to employee's pay; total daily or weekly straight time earnings; total weekly overtime excess earnings; that is, the amount paid solely as overtime above all straight-time earnings; total wages paid each pay period and the pay period covered by each payment.

Though education and voluntary compliance have featured the administration of these two laws, both Acts have "teeth" in them. Penalty provisions of the Wage and Hour Law include for wilful violators a fine up to $10,000, and, in the case of a second offense, imprisonment up to six months, a fine, or both. Disabilities that may result from failure to comply with the Walsh-Healey Act include cancellation of the contract, and, where flagrant violation is found, employers can be blacklisted from federal contracts for a period of three years.

Plant Trucks

(*Continued from page 168*)

commutator brush surface should become rough, burned, pitted, or excessively worn, the armature should be placed in a lathe and the copper turned down just enough to give a true surface. The mica between the copper commutator segments is undercut to 3/64 in. below the copper brush surface on new commutators and should be undercut as often as necessary to prevent the mica from becoming flush with the copper brush surface.

Slightly round all sharp edges on the copper segments, after turning or undercutting, and remove all chips, sharp edges and copper dust from the grooves between the segments. Care must be taken to prevent the copper chips and dust from lodging in the armature winding, while reconditioning the commutator by using a suitable hood covering over the end windings.

Pump Motor

The same procedure suggested for the inspection and overhauling of the traction motor should be followed in the case of those industrial trucks equipped with a motor driven gear-and chain or hydraulically operated hoist and tilt mechanism, except for the differences in the method by which the motor is removed or opened.

Details vary according to the particular type of truck involved, but generally it is first necessary to disconnect the coupling between the motor and the pump. The mounting screws may be differently located, but an inspection will make it readily apparent what changes need to be made in the routine, as already mentioned in connection with the traction motor.

(*Turn to page 324*)



"Congratulations on Jumbo Jrs' *ability to withstand terrific punishment*"

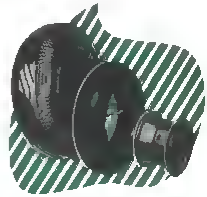
No greater proof of the ability of General Jumbo Jr. industrial pneumatic tires to stand up and *perform* in *any kind* of service can be found than in the following letter from Ralph H. Swaisgood, President, Pacific Engineering Corporation, Los Angeles.

"One of our Aerostands was recently towed behind a car from Los Angeles to Wright Field, Dayton, Ohio. The Jumbo Jrs. used were 16" and turned over better than 3,000,000 revolutions at high speed during the road test. Terrific heat was encountered, especially across the desert.

"Since the Aerostand has no spring arrangement, the entire shock had to be absorbed by the Jumbo Jrs., and believe us some of those roads were rough.

"Our Aerostand was designed to be towed behind Army equipment over any terrain . . . so you see General Industrial Tires get the tough jobs. Congratulations on their ability to withstand terrific punishment."

Available in new Air Corps specification sizes. Also for war orders and for certain essential industrial uses.

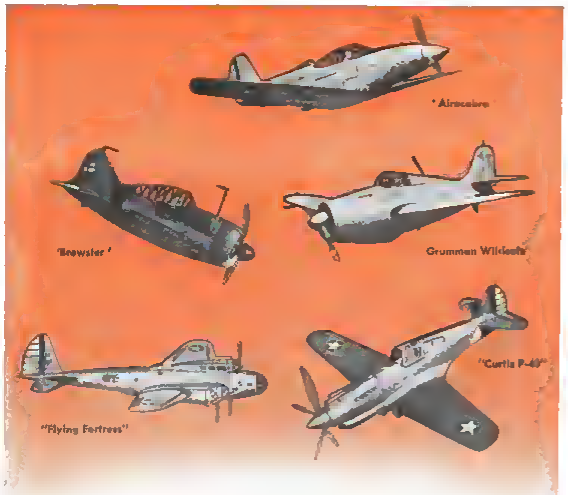


Tires 3" to 24" overall diameter. Load capacity 100 lbs. to 3500 lbs. per tire. 2-4-6 and 8 ply with regular tetons and heavy-duty wheels. Exclusive and patented* the designed the Jumbo Jr. makes possible a type of high speed or low speed application equalled by no other industrial pneumatic.

THE GENERAL TIRE & RUBBER COMPANY • AKRON, OHIO

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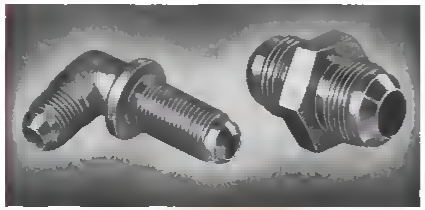
GENERAL JUMBO JR.
INDUSTRIAL BALLOON TIRE



The Grinnell Company is supplying major aircraft companies with

"AN" Standard Fittings for Aircraft Tubing

We are anxious to help you eliminate delays and are stepping up our production to this end. Grinnell Company, Inc., Executive Offices, Providence, Rhode Island.



GRINNELL
WHENEVER PIPING IS INVOLVED

Plants, Branch Warehouses and Sales Offices in Principal Cities

Controller

1. Blow out all dust and grit with clean *dry* compressed air
2. If required, oil contact cam rollers through holes provided insulating support and oil reverser shaft bearing. Use an accepted lubricant in a long snout oil can
3. Replace any broken springs or shunts and check all connections for cleanliness. Tighten if loose
4. Inspect contact tips for cleanliness and wear and carefully remove any roughness on contact surfaces with a clean fine file. Contact tips worn halfway through should be replaced
5. At yearly overhaul period, remove, clean, and repack main shaft bearings with an accepted ball-bearing grease
6. Both the contact tip pressure and the tip gap (distance between the tips when the contactor is open) should be checked periodically

Contactor

The contactor should be inspected at the same time the controller is inspected, as follows

1. Use clean *dry* compressed air to blow out all dust and grit being sure to blow out all metallic dust from contact points
2. Replace any worn or broken points
3. If the contact tips are badly burned, dress down with a fine file (Do not waste contact metal.) Replace tips when worn halfway through
4. Inspect cable and shunt connections for loose or faulty electrical contact.
5. Periodically check contact tip pressure and tip gap

Note: Specific information relative to coil operation and contactor adjustment should be obtained from the manufacturer

Accelerating Resistor

1. Blow out all dust and dirt with clean *dry* compressed air, and check all connections for tightness
2. Check both resistor ribbon and porcelain insulator for damage or breakage

From the foregoing, then, it is obvious that proper maintenance of this important piece of industrial equipment—maintenance that will largely eliminate expensive breakdowns and replacements—is based solely on the common-sense theory, often disregarded, of preventing trouble before it starts

Flight Strips

(*Continued from page 249*)

no obstacles are permitted to stand above a 30 to 1 gliding angle (preferably 40 to 1) projected from the end of the run

(*Turn to page 327*)

You lucky So-and-So
TO HAVE
BLACKHAWK WRENCHES



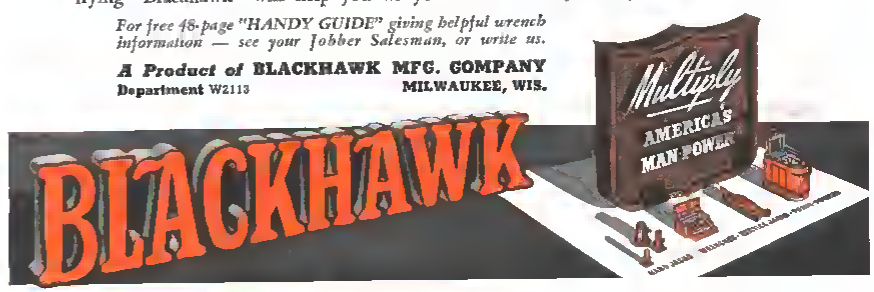
THERE'S deep, dark-green envy today in the hearts of mechanics who have to watch a buddy use Blackhawk Wrenches. He uses 'em with such ease and confidence — never a lost motion. Man, those wrenches are *really built* — to get into the tough spots and handle the cussedest jobs without cussing.

You bet! Modern BLACKHAWK WRENCHES are rugged, speedy, dependable — yet slim, trim and light to handle. They've got so many exclusive features for better performance that they're rated "tops" in fightin' tools by aviation and automotive industries, every step of the way from production to repair and service.

If you buy your own wrenches — go to your nearby Blackhawk Distributor. *If your Company supplies the wrenches* — have confidence in knowing that requisitions specifying "Blackhawk" will help you do your work better, easier, faster and safer.

For free 48-page "HANDY GUIDE" giving helpful wrench information — see your Jobber Salesman, or write us.

***A Product of* BLACKHAWK MFG. COMPANY**
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"IF BIRDS CAN FLY IN THIS WEATHER . . ."

Compared to such factors as the skill and courage of American pilots and the excellence of American instruments, the part played by Delco aircraft windshield wiper motors in getting our bombers through "dirty" weather is indeed a small one. But that part is nevertheless essential, and Delco Products is seeing to it that these motors won't let the boys down when the going is tough.

Delco Products also supplies the aircraft industry with Delco foot pump motors for starter and booster duty, precision instruments and hydraulic equipment.



DELCO PRODUCTS DIVISION OF GENERAL MOTORS CORPORATION
DAYTON, OHIO

way extension. Clearance is likewise required along either side of the strip extending above a plane projected on a 7 to 1 slope from the edge of the runway and runway extensions for a zone width of at least 500 feet. Thus it will be noted that the approach areas are of a greater width and flatter gliding angle than can be found at most airports.

Normally, a length of 8,000 ft. is called for in the strips designed for military purposes, though there may be occasions when an otherwise excellent site may fall short of this length. Generally, the total width of the strip runs from a 500-ft. minimum to a 1,000-ft. maximum. As for the paved runway—usually of 150 ft. width—the length ranges from 4,000 ft. on sea level sites to 8,000 ft. on strips at altitudes of 8,000 ft.

To provide additional runway, at low cost, for planes requiring it, there is a runway extension appended to each end of the paved runway and usually consisting of some form of soil stabilization. Shoulders, on either side of the paved strip, have a width of 175 ft. and extend for the entire length of the paved runway and its extension. On certain strips, portions of the runway shoulder areas are stabilized, turfed, or surface treated with bituminous material.

Runway and shoulder grades are relatively flat, with maximum transverse runway grade 1½ percent and minimum slope 1 percent. Runways may have one-way or two-way transverse slopes, the surface in the latter case being made up of two intersecting planes—a low-angle "inverted V." Thus, the possibility of water standing in the much used central portion of the runway is avoided. Parabolic or circular crowns are shunned, for though seemingly feasible in theory they are often "humpy" following actual construction, hence are unsatisfactory.

Maximum transverse slope of shoulders is 1 percent, with a minimum desirable slope of ½ percent, and in no case do shoulders slope toward the runway. Maximum longitudinal grade of runways is 1½ percent, with 1 percent not to be exceeded if feasible.

Many of the projects have an unbroken longitudinal grade throughout runway and extensions. Maximum rate of change, where changes in grade are used, is ½ percent per 100-ft. station. Vertical curves preferably have a length of 500 ft., with a desirable minimum of 300 ft. Every effort is made to obtain longitudinal tangent intervals between vertical curves of not less than 1,000 ft.

Sight distances along the runways, states Mr. Schnepfe, are designed to permit an unobstructed view along their entire length, as determined from a pilot's-eye elevation of approximately 10 ft. above the runway surface.

In structural practice, design of a sub-

two a pioneers!

AR FEATHERWEIGHT RELAY



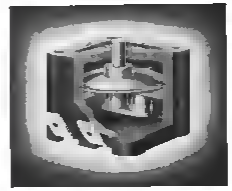
The **AR** Featherweight Relay is a rugged performer despite its low weight of 50 grams and minute dimensions of 15/16 x 1 3/16 x 1 5/8 inches.

Its contacts handle 5 amperes at 24 volts DC or 110 volts AC, single pole double throw.

The **AR** can be furnished with a variety of coils to operate at from 1.5 to 58 volts DC and from 6 to 115 volts AC. Coils are impregnated to withstand humidity and all bakelite parts are wax impregnated. *Model AS when insulated from frame.

The **AR** Featherweight Relay is designed to meet Army, Navy and C. A. A. specifications.

NOW! A BAKELITE CASE TO ENCLOSE ALLIED'S A3 AND A5 HC SEALED SWITCHES



Thousands of Allied **A3** and **A5** HC Switches (in ceramic cases) are performing their functions in electrical equipment in every part of the world . . . their working design and parts have been proven and accepted as standard equipment . . . in the engineering and in the designing of the New Bakelite Case for weight saving and greater structural strength no changes were made in either working design or parts.

Features of the New Bakelite A3 and A5 HC Switches include:

CONTACT ARRANGEMENT:
A3, single pole single throw normally open, double break. A3, single pole single throw normally closed, double break.

CONTACT RATING:
non inductive, 50 amperes at 12 and 24 volts DC and 110 volts AC.

WEIGHT:
four ounces.

OPERATING PRESSURES:
1¾ to 3½ pounds, stainless steel plunger travel differential, A5 make to break travel 0.006 to 0.012 of an inch, A3, break to make travel 0.005 to 0.012 of an inch.

OVER TRAVEL:
0.050 to 0.070 of an inch at maximum pressure.

VIBRATION:
10 G for either horizontal or vertical positions.

ALLIED CONTROL COMPANY, INC. 227 FULTON ST., NEW YORK
Factories: NEW YORK CITY • LONG ISLAND CITY • PLANTSVILLE, CONN.

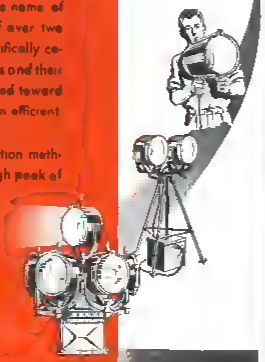


LIGHTING THE WAY...

Our efforts in "Lighting the Way" to a new approach to the problem of production by assembly and sub-contracting are indicated in the results achieved. We are profoundly grateful that our methods in collaboration with sub contractors and our joint accomplishments have merited the coveted Army Navy "E" award. Such an honor will be a constant inspiration to dedicate even greater efforts to the American cause and the Victory that will be won!

In the production of airport, aircraft and marine lighting equipment that bears the trade name of LIGHTS, INCORPORATED, the efforts of over two hundred manufacturers have been scientifically coordinated. Thousands of skilled mechanics and their tools, which might otherwise never be used toward the war effort, are now directed upon an efficient *Victory-assuring* program.

Just as certain sub-contracting production methods were developed and brought to a high peak of efficiency by Lights, Incorporated, *so also* were the products of the company—which include all types of standard and specialized lighting equipment, many restricted products for use by the Navy, Army and Ordnance, and the new Butex synthetic rubber.



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grade of sufficient and uniform bearing power is an important consideration, hence soil studies have been conducted at each location to determine the bearing values of the natural subgrades, and deficiencies are corrected where necessary. Thickness of the prepared subgrade depends on the maximum loads it is to support, in ratio to the bearing value of the material and with climatic conditions considered.

Runway pavements are designed for wheel loads of at least 12,500 lb., and they are always safe for much greater loads or may readily be strengthened to carry the heaviest planes. It may be pointed out that there is a definite trend away from the practice of adding an impact factor to the static wheel load, since it has been observed that surfaces of the flexible type, including the various bituminous treatments, do not fail under forces developed in landings or takeoffs by planes for whose static wheel loads the surface has been designed.

As for comparisons between the use of highway surfaces and that of similar rigid pavements on flight strips, it appears unnecessary to consider concrete fatigue in the design of the latter—for the time duration of stress from dynamic loading is probably appreciably less on a runway than on a highway, moreover the frequency of load repetition at a given point on a highway pavement is much greater than on a flight strip. While the maximum wheel load of present day airplanes is several times greater than the maximum wheel load permitted by law on highways, the size of landing wheel tires on aircraft is correspondingly greater than the size of tires on highway vehicles.

Thickness and support of a given type of pavement determine its structural strength. And for flexible-type surfaces, the thickness of the wearing surface, base course, and subbase considered as a unit, are in part predicated on past behavior of soils in highway and airport construction and in part upon results of research.

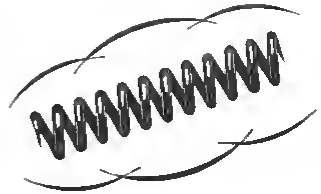
An article published by the PRA—*Classification of Soils and Control Procedures Used in Construction of Embankment*—may be mentioned as a guide to the study of soil characteristics and their classification as related to thicknesses of flexible-type pavements. Moreover, California's Highway Department, after long investigation of design and service of flexible-type highway pavements, has developed a method of designing the bearing capacity of such pavements.

Subsequently (June of 1942) the War Department, Office of the Chief of Engineers, published Chapter XX of its engineering manual titled, *Design of Runways, Aprons, and Taxiways at Army*

(*Turn to page* 331)

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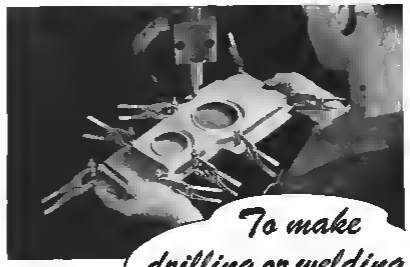
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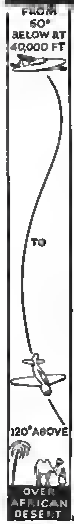
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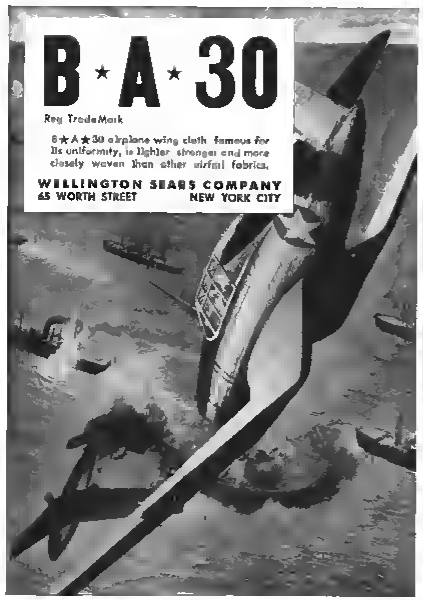


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In *Force Stations*, a brochure which contains curves, illustrations, and data for designing flexible-type pavements based on the theory and practice developed in California. Mr. Schnapfe believes this study will go far in clarifying design principles.

A total thickness of as much as 24 or 30 in. may be required for the heavier wheel loads with soils of low bearing values. But for lighter loads, higher-type surfaces, and soils of high-bearing value, as little as 6 to 10 in. total thickness may be adequate. Bituminous wearing courses or flexible bases are seldom less than 2 in. in thickness. Meantime, because of war restrictions, use of steel in concrete pavements is being limited to a minimum compatible with sound procedure.

Though drainage of strips is a primary problem, it is still a relatively simple one when compared with the requirements of airports having a number of intersecting runways. Subdrainage structures common to airports may be entirely eliminated or used to but a minor extent. On the strips, the runoff from rainfall or melting snow flows across the runway pavement to shallow open ditches along outer edges of the strip areas.

If storm drains or subdrains are needed, they may be open joint, or equally suitable, pipe placed in a trench and backfilled with gravel or crushed stone to a point 12 in. below the trench. The top 12 in. is composed of coarse stone premixed with bituminous material firmly tamped down or rolled into place. This prevents displacement by wheels or prop blasts, while serving as a transition strip for aircraft passing from the runway to the shoulders.

With the 150-ft.-wide shoulders, it is not always necessary to carry mechanical stabilization the entire width. For about 75 or 100 ft. is generally sufficient. Here, the shoulders bear the same relationship to the paved runway as do highway shoulders to the paved roadway. In short, they are primarily "run over" areas. Hence greatest stabilization should be adjacent to the paved runway and may be decreased from that point outward.

Over either stabilized or unstabilized areas it is frequently desirable to either seed or sprig when the soil and general weather conditions are such that grass will grow. Where grass won't grow, a bituminous dust layer may be applied.

Runway visibility may be obtained either with a painted stripe around the runway or by use of a finish of light color aggregate on bituminous surfaces. In some instances, fencing may be called for at the boundaries of the strip to prevent hazards to aircraft from grazing animals or trespassers—and vice versa.

Of the principal construction operations — clearing, grubbing, grading,

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drainage, and paving—grading and paving are the most expensive, time consuming, and important to the strip's successful operation. Since speed of construction is now vital, pavements are likely to be placed speedily, hence optimum compaction of fill material is essential to avoid subsequent settlement of the pavement and damage to it.

A number of types of bituminous surfaces can satisfactorily be made with local aggregates. Sand asphalt pavement and several kinds of open and dense graded bituminous mixtures are examples. A type commonly used is the plant-mixed bituminous surface laid to a minimum compacted thickness of 2 in. Also acceptable are extra heavy surface treatments not less than 1½ in. thick for relatively light traffic, penetration macadam, roadmix, or mixed in place surfaces.

Use of flight strips as points-of-call for cross-country trainees is recognized as feasible. Groups of students and instructors may fly to such strips for training periods, thus relieving congestion at the major base. Practice of aerial gunnery and bombing may well be conducted, moreover, at strips which are at a distance from centers of population. These uses, of course, would be in addition to the military maneuver, ATC ferrying, and coastal defense utilization of the strips.

Granted, a number of the flight strips now being completed for the military program are not so located as to be of greatest value for post-war use, but these strips are justified as a war measure. Others—indeed, the majority—have been located to fit into the planned expansion of air transport and private flying of the future.

Since flight strips of the military class are made to "take" heavy planes, where properly located they will readily be adaptable for civil transport flying, particularly for feeder work, where they may be used to bring air service to small communities. Such radiating services have long been planned, but this is the first definite action to provide the required "grounding."

In this respect, states Mr. Schoepfe, it is to be noted that at the start of the war, less than 500 cities enjoyed air service. But in the postwar period there is every possibility of bringing aero service to as many as 5,000 communities. "Surely," he contends, "broad facility and protection will be afforded to the great new body of private flyers by these flight strips."

Fighting Snow

(*Continued from page* 203)

V-plow feeding two rotary blowers.

The rotary units now available for airport clearance are substantially the same machines designed for use on highways after several passes of a plow have built up a bank against which they work at a steady speed. Recently, to better meet the needs of airport clearance, some of the rotary units have been speeded up so they pick up and throw the snow while traveling at speeds up to 20 mph, and this has generally proven an advantage. Most of the rotary blowers remove a swath not more than 8 ft. wide, and handling the shallow depths of a usual snowfall for this width does not feed sufficient snow for the machine to operate at its greatest efficiency. Plows can be used to supplement the rotary units by windrowing the snow. Some manufacturers have experimented with an angle blade on the machine, feeding into the rotary unit, to increase the swath width.

A recent development along this line combines a powerful motor truck with an offset V-front plow and a long wing into which is built a power-driven rotor. With this unit, snow is picked up by the plow and discharged along the wing by the powerful thrust of the truck; the rotor boosting the speed of discharge and helping to throw and disperse the snow. The faster the truck moves, the

(*Turn to page* 335)



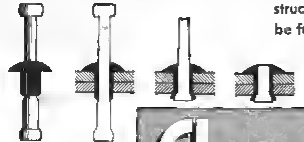
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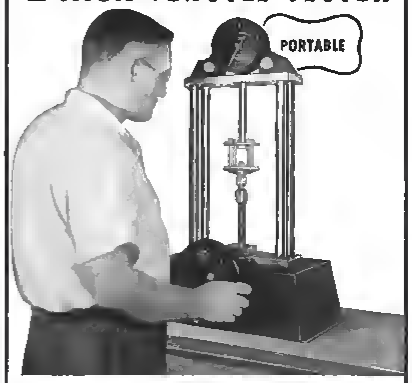
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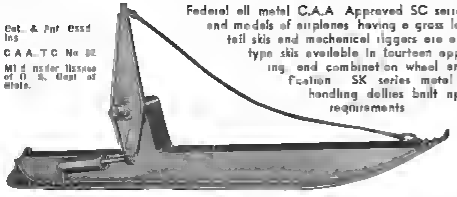
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greater the velocity of the snow as it approaches the rotor, which serves merely to increase its velocity without forcing it through an orifice or changing its direction of motion. This unit, to be effective, requires a truck with high tractive power and capable of sustained speed over a range of rates.

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Crawler tractors with angle-dozer blades will be found useful for opening up areas and hauling or pushing equipment around. They may be especially desirable on military fields where it is necessary to get to dispersal pens with an easily maneuverable unit. A power-driven circuit broom of the street cleaning type is useful to clear snow from the contact lights and to brush up the snow in particular areas after a plow has passed.

Some machines can be utilized for snow moving that are not designed or intended for the purpose but that happen to be nearby when an emergency arises. Availability of equipment and ingenuity of the operators are the only limits to the value of such borderline machines.

Patrol graders with earth working blades have limited usefulness for airport snow removal as they are not designed to throw the snow. However they are very useful for removing ice and for windrowing snow for subsequent handling by other means, and if a patrol unit is equipped with front mounted plow, and possibly wings, it can be made into a powerful snow mover.

Another borderline machine is a carrying scraper, not recommended as an efficient snow moving unit but certainly capable of emergency service. No records of airport operations are available, but it is suggested that the carriers be used with one or more patrol blades or plows to windrow the snow and shorten the travel necessary for loading the carrying unit. Snow must be well compacted to force itself into the bowl and positive ejectum is necessary for discharge. To illustrate the possible capabilities of the carrying scraper unit, its operation on snow removal from streets might be cited. At Fargo, N. D., snow was pushed to the sides of the street until compacted banks 2 to 4 ft. high flanked each sidewalk. Under this snow was a layer of ice from 2 to 6 in. thick. A 12 cu.yd. scraper removed the snow and ice from an average 350 ft. long block each hour.

Besides clearing the actual runways, a considerable amount of other opening up must be done, as for example on taxiways, hangar entrances, walkways and approach highways. Plow and rotary equipment can be used, but may be supplemented by side wall

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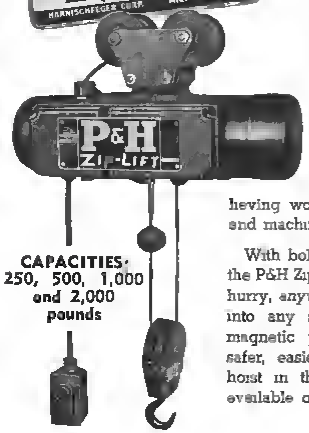
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width plows propelled by light tractors and by snow loaders and trucks for hauling snow out of the area around the buildings. Loading snow is not especially recommended as it is more economical to push it out of the way, if space can be found, and permit it to melt for storage.

Whatever equipment is used, it should be of a proven type, designed for continuous operation. Operators express preference for trucks that drive on all wheels and state that they should be of a size comparable to the plows they must push. Such trucks should be equipped with special multi-speed transmission, as the snow-moving units are most efficient when the truck speed can be adjusted to the optimum speed for snow handling. Speed is essential for snow handling with plows, since they throw the snow best at the maximum speed at which they can be operated constantly.

Rotary blowers are governed to one or two speeds, hence the truck travel must be adjusted closely to keep snow always at the intake but never choking the engine or stalling the truck. For propelling rotary plows there is no substitute for adequate power, for a machine operated at full throttle cannot be depended on for 24 hr. a day service. Heavy-duty rather than automotive power units are desirable, and they should never be operated faster than the manufacturer's recommended speed.

As an illustration of what equipment may be called upon to do, experience at one Canadian airport may be cited. The total fall of snow through the winter was 113 in. of which 52 in. fell in January. Keeping the runways open during the month required that a tractor hauling rollers be operated 453 hr., a rotary blower 412 hr., and a plow 386 hr. In one period the tractor operated 12 days, the rotary 8 days, and the plow 9 days with only service stops. Men and machines must be in good condition to stand such work in extreme cold and stormy weather.

Snow removal truck operators are generally agreed that single tires are best for this work. The use of single tires of the same size on all wheels not only conserves rubber but also relieves excessive differential action in the driving mechanism, thus prolonging the life of the truck. Closely spaced tire chains, rather than the more common emergency type of tire chain, should be available for all the wheels of the truck or tractor unit. These will give maximum traction with minimum slippage and least damage to tire equipment but should not be put on until conditions are such that wheel spin or troublesome side thrust develops.

The machines available, the expected

(*Turn to page* 339)

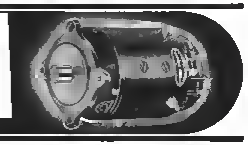
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rate and duration of snowfall, and whether the snow is fluffy and dry governs the time snow removal should start. Weather reports should be carefully studied so that personnel will be on hand when needed and so that plans can be made for clearing snow from the runways that lie in the direction of the wind as soon as the snow becomes deep enough to be troublesome. Removal or other processing of snow must be started in conformity with the storm and continued until the snow is under control without regard to shifts or to 40 hour week limitations.

If the snow is dry, fluffy, and not drifting, a transport type plane can land safely in as much as 6 to 8 in. of snow. This amount will not retard the speed at which snow removal units may operate, nor will it be a menace to operation of moderate sized planes, as in emergencies they have landed in 18 in. of soft snow. If the snow is moist and the expected fall is heavy, removal should start when the depth is only 2 or 3 in., to avoid building up to greater depths before clearing can be completed. Aircraft equipped with high pressure tires are capable of operating from airports having considerably more soft snow than can planes equipped with airwheels due to the larger tire area of the latter and the resulting greater resistance.

Clearing With Plows and Blowers

Probably the most desirable method of clearing snow from airports is use of plows and rotary blowers together. When adequate equipment is available the usual procedure is to build up a windrow with the plow and then blow it off the landing areas with the rotary unit. The size of the windrow is determined by the size with which the available rotary works best, as some of them are designed for slow speed operation against a large bank and others for more rapid movement in medium depth snow. As soon as a windrow is built up so the plows slow down, the blower unit should go into operation. When there is little wind, or when the wind is straight down the runway, clearing should begin at the center and the snow moved to each side. In a strong cross wind clearing should start on the windward side and the snow carried entirely across the area to be opened. Rotary units will throw the snow 50 to 90 ft. with, or 40 ft. against, a moderate wind, but it is almost useless to attempt to blow snow into a storm.

The first runway should be cleared by successive passes of the equipment for the runway's full length with no attention given to the fact that snow is being deposited on other runways at the intersections. After the first runway is made usable, the next to be cleared is the one indicated by the weather reports as in the probable direction in which the wind will change. Lacking this information, a runway about at right angles to the first should be cleared.

Snow should be cleared to the full width of the runway and to beyond the runway lights, usually just a few feet outside paved runway areas. Subsequently, as convenient, it should be cleared to some greater width depending on expected snow fall during the season. Equipment should not be operated over turf areas outside the runways when the ground is soft and there is not sufficient snow to prevent machines breaking through. Banks at the edge of the cleared area should be sloped to a rise of not more than 3 ft. in 100 ft. if possible. This plan will reduce damage to planes running off the runway and prevent forming traps for drifting snow.

A cleared width of runway of 150 ft. is desirable but, where snowfall is heavy and moist and removal is difficult, 125 ft. will generally be found a safe minimum for transport type planes. It is advisable, however, to clear to as great a width as possible in the early part of the season to keep down banks that will build up on either side of the cleared area if the total fall of snow is heavy during the winter.

Where the runways intersect at oblique angles excess snow is bound to accumulate in the V formed between the runways. Methods of disposing of this snow differ, but the simplest seems to be to shift the deflectors on the rotary plows to throw snow away from the cleared runway. Usually this procedure must be supplemented by added maneuvering including some diagonal cuts and backing to throw the snow out of the V. Rotary plows can sometimes be most effectively operated in successively widening circles at the intersections. Occasionally it may be necessary to throw the snow farther back on the unpaved area to provide a place to dispose of succeeding snowfalls. The angle of intersection, depth of snow and velocity and direction of the wind will dictate the procedure necessary to be followed at a particular intersection.

Clearing With Plows Alone

Successful clearing of airports with plows alone requires an understanding of the limitations of various plow units. Airport snow removal is totally different from highway plowing as the snow must be carried a long distance, often in a cross wind, and high banks must be avoided.

It has been found in actual plowing operation that no one piece of equipment will do the complete job efficiently. Long experience on a municipally owned Vermont airport, where the average snowfall has been 105 in. per year, has



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resulted in the use of three distinctly different types of plows. Clearing here has been done under an annual contract by the Vermont Road Equipment Co.

The physical conditions of this port have recently been changed, but until this summer, the port had two runways, one north and south, the other northeast and southwest. The runways were 2,600 and 2,400 ft. long, with 100 ft. width of mixed-in-place surface and with grass covered safety strips 100 ft. wide on each side.

The plan for winter operation at this field is to maintain a cleared strip at least 200 ft. wide at all times. To make this possible, early plowing is done to a total width of 350 ft., and after banks are once established, each successive fall of snow is plowed against these banks. Plowing usually is started when the depth of snow reaches 2 in., and is continued as necessary until all snow is off the runway.

Operations are started with a 1½-ton truck equipped with a 7-ft. one-way blade with deflecting moldboard. The first trip is made in the center of the runway and the snow pushed to each side. By narrowing the width of the cuts on each trip it is possible to keep up the truck speed and to handle the increased volume of snow as it piles up. The 100 ft. wide hard surfaced area is usually cleared in nine round trips, the truck being operated at from 20 to 25 mph., depending on the density of the snow. It has not been found practical to do much plowing with the light truck off the hard surfaced area.

The next operation is use of a similar but larger one-way plow to widen the cleared area on the turf landing strip outside the pavement. This plow is mounted on a 3-ton, rear drive truck, which has a single, right-hand, rear mounted 8-ft. wide leveling wing. The first cut made is about 5 ft. wide with the wing raised on an angle from 0 in. on the inside to 8 or 10 in. at the outer end. The action of the wing in this position is to disperse snow with very little added draft on the truck. This unit is operated at a speed of 15 to 20 mph. and can be used efficiently for a width of about 50 ft.

To move the accumulation of snow from this plowing, a heavy-duty V-plow is employed with a right-hand front-mounted, high-lift, leveling wing mounted on an all-wheel drive truck. Only half of the nose of the plow is used in making a cut about 4 ft. wide with the wing raised from the ground to a position where a full wing load is carried at all times. Speed of the truck on the first cut is from 10 to 12 mph., but a reduction of speed is necessary on each trip since more snow has to be handled.

The procedure followed at intersections of runways where a sharp V is formed is to make successive thrusts straight into the snow with a big truck and the V-plow. The snow is carried back to a spoil area between the runways, a cleared depth of from 300 to 400 ft. being desirable. A light truck is used to clean up the spill from the V-plow on the runways and at intersections.

Banks are usually from 6 to 8 ft. deep after each plowing and before settlement takes place. It is practically impossible to widen the runways farther once the snow has been permitted to settle. Thus, it is essential that a sufficient width of open area be established in the first plowing to assure that the desired runway width will not be encroached upon despite unusually heavy falls of snow during any winter. For the wider runways now used on many ports, the width cleared in the original cleaning should be larger proportionately than that used on the port described.

Ice on Runways

Snow should be cleared as close to the runways as possible. Sliding shoes or casters supporting the blades can be adjusted to permit clearing right down to the surface of a smooth runway. Any remaining snow is usually blown off by propeller blasts or melted by the heat of the ground or the sun. Along the seacoast however, ice may be expected to form from packed snow, sleet, or light rain freezing as it falls. This ice can sometimes be removed by underbody blades on trucks or by blades on patrol graders, but this is a time-consuming operation where the ice area is extensive. Also, care must be used to guard against damaging the airport surface with the threads of tractors, cutting blades or plows. If the surface seal is broken, water getting to the subgrade may freeze and cause heaving of areas on the runways. Some clearing units have a safety trip on the blade that releases when it gouges into the surface or strikes obstructions, thus reducing the damage to the machine and to the paving.

Sanding Runways

Rather than clearing ice by mechanical means, abrasive material is often used to skidproof the affected areas. Sand, applied with the spinning spreader used on highways, is a preferred means of skidproofing. Spreading units fit into the rear of a truck body, often those used for snow removal, and have a powered centrifugal spreader that casts the sand over a moderate width. The units generally available are those developed to spread only over a two lane highway and will require extra trips when they are used on the airport.

It is advantageous to use hot sand as the particles embed themselves in the surface and thus resist propeller blasts and wind. Asphalt dryers have proved satisfactory for preparing the sand and are quite often available in the winter when their normal use is suspended. At one airport, heated sand is secured from a commercial concreting plant, but in case of necessity it can be heated over a long pipe in which a fire is built. A serious difficulty in use of sand is freezing of the stock piles. This condition may be alleviated by keeping the piles covered, but the covering must be done early enough to permit the sand to dry before cold weather.

Although commercial outlines have not generally favored the use of chemicals, which have a tendency to cause oxidation and rusting when splashed on the planes, the Civil Aeronautics Authority and the army air force authorize the use of calcium or sodium chloride for clearing runways of ice on airports under their jurisdiction. Suggested methods is to mix 50 to 75 lb. per cu. yd. with up to ¾ in. abrasive material, making the chloride into a brine and treating the material as it is put into storage piles at the airport for winter use. Cinders and sharp, coarse sand are the preferred abrasive materials. It is expected that flake chloride will be added as the material is loaded for use, depending on ice thickness and atmospheric and temperature conditions. Rate of application to the runway surface should be 1 to 1½ lb. per sq. yd. of the abrasive material.

Helps for the Operator

Many small devices and schemes can be used to make snow removal easier and operation of the machines safer and easier. Controls for plows, wings, and other facilities attached to the trucks should be of a mechanical type that permit making any changes regularly necessary without leaving the cab. A powerful spotlight should be supplied and regular lights mounted on the top of the cab or some other high point since those on the truck may be blocked by the equipment. Cabs of machines should be tight so that they can be kept warm by a heater.

Satisfactory operation of snow handling machines on clearing or compacting will be greatly enhanced if it is possible to keep in constant contact with the operators. Two-way radio communication with the airport control tower is desirable, and receiving equip

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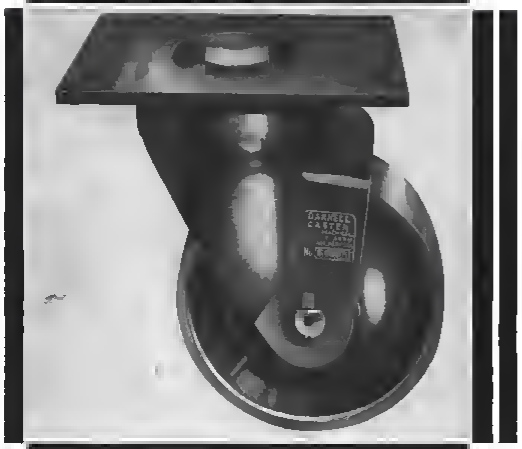
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ament in the truck is essential. Safe operation demands that the equipment on the runways be under control from the tower, and it is helpful when acknowledgment of orders can be made and frequent reports given on the runway condition, especially at night during a snowstorm. Where several pieces of equipment are in use it is satisfactory to have communication with a supervisor's car only if it can be used for continuous contact with all equipment. On one municipally-owned port where radio equipment for the trucks are not used, an expedient of a police car with two-way radio was employed. This was not entirely satisfactory, however, as the police car could not communicate directly with the tower, it being necessary to relay messages through the police central station.

Heated storage should be provided for the motive equipment used on airport clearing. The big machines use heavy lubricants when they are to be operated at full-rated speed for many hours. Such lubricants make the engines very hard to start when cold and may become so stiff that they do not protect close-fitting parts when cold. Also, use for snow removal causes the machines to become coated with snow and ice that must be thawed before they can be properly serviced.

Personnel is a most important item in winter airport maintenance. Ordinarily one man can actually operate the machine, but it is good policy to have an extra man on it to help with the unexpected things that may occur. The men must be familiar with the machines and, even more important, with the field. There is no substitute for experience in knowing what a machine will do, how to make minor repairs, or where to go in a blinding snowstorm. Most snow removal is done by men working on 12-hr. shifts as the work is not continuous enough to justify having three shifts of trained workers. In nearly all cases the men have an "esprit de corps" that is just as loyal, just as efficient and dependable as that of pilots, and they will work any hours to get the airport in shape for its intended use.

Metallizing

(*Continued from page 235*)

lighter than normal. The demonstration showed the metallized-conditioned engines to have superior qualities to those of a new, or ordinarily rebuilt, engine in the same time limit.

Spraying was accomplished with an almost negligible metal cost per cylinder, with spraying time averaging from 1 hr., grinding time 4 hr., so that a substantial saving is offered in salvage of these carbon steel barrels, which are lathe turned out of a forged tube, then shrunk into an aluminum alloy head, all representing an expensive unit not only in material but in construction time. The metallized cylinder with its advantages can be turned out for about one-seventh of the replacement cost (if replacement were possible).

Most plants throughout the United States have one or more metallizing outfits in use to keep production machines in operation. This application primarily involves the use of sprayed deposits to replace worn circumferential areas on machine elements—worn bearings of almost all types. It may mean a spindle on a lathe, a pump shaft on a grinder, a motor bearing on a router, or it may involve some vital bearing on a drop hammer or drill press.

Practice of using the metallizing process in building up worn lubricated bearing sections is well established. And due to the peculiar characteristics of sprayed metal—which because of its slight porosity absorbs the lubricant in such manner that a much longer wear life is obtained as compared with the original bearing—metallizing is found superior in this type of application to any other process. Welding is seldom feasible because of the distortion and heat strains created, and the use of sleeves or shims is a makeshift.

Metallizing Saves Time

Some airplane manufacturers, prior to the widespread adoption of metallizing, attempted to keep production machines in operation by older methods, or they sent worn parts out to a metal-spraying shop, of which there are now several available in all industrial centers. The latter method is efficient—the one objection being that with the tremendous expansion of airplane manufacturing plants, it sometimes requires several days to get the part to the job shop, let the contract, explain the details of the specification required, and get the return of a part to the production machine. But when a metallizing outfit is available in the maintenance department, it is usually only a matter of hours before the shaft or bearing is restored to original condition and the machine is back in operation.

Maintenance Examples

As examples of maintenance department uses of metallizing by experienced aircraft manufacturers, typical operations which have been found particularly pertinent include:

Building up of water jacket surface on drop hammer shaft with stainless steel



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Building up roller bearing surface at end of shaft on high frequency generator with 25 carbon steel. (This required about 30 min. actual operation of spray gun.)

Production Uses

Some of the operations, other than for maintenance, to which airplane manufacturers are applying the metallizing process are described herewith.

In model departments, the process is used for building up wing sections and other parts which have been mismachined or which require additional metal to meet experimental changes. Two such jobs done by a leading manufacturer in the past year effected large savings and saved several weeks' time on vital models.

In tooling and jig departments, many applications have been used involving adding metal to jigs which had become worn or were undersize. In such cases, welding will not do here because it warps the part. By metallizing no warpage occurs.

It is often desirable to use solder on Kirksite, but this is impossible. Some plants desire to fasten chrome-molly, or other metals, to Kirksite dies or forms. They must use rivets or other mechanical means which are not fully satisfactory. But, through the metallizing process, a recent development shows that copper may be sprayed on Kirksite, and other metals may be sweat-soldered thereon.

By using the recently developed replica method, a precise duplicate of any plaster, wood, or metal form may be made by spraying high carbon steel or other metals thereon. This permits the making of forming dies quickly and cheaply, and such items have already been used satisfactorily in hydro-press work.

The metallizing process is used satisfactorily in the repair of various types of drop hammer and other forms of forming dies, molds, etc., when they become low in spots and require an addition of metal. Experiments are being conducted, with very satisfactory indications to date, using the process to fill riveted seams with molten metal for the purpose of "fluxing" and also for the purpose of sealing to reduce air pressure leakage on planes which fly at high altitudes. Equipment for this latter use is not yet in production, but it may be soon.

In addition to the above applications, aircraft manufacturers are carrying on extensive research work, using the "magic process of metallizing" with high hopes of solving many more important problems.



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Air Cargo

(*Continued from page 257*)

cision, the board's control over Railway Express Agency is greatly increased. Although it formerly had some control—since it had to approve the contracts between the agency and the various airlines—this control was at best indirect. Now, however, the fact that Railway Express Agency has been held to be an air carrier changes the situation, because the CAB, when it finds that any rates, fares, or charges received by an air carrier for interstate air transportation (which includes the transportation of property) are unjust, may prescribe the lawful rate.

Recent events show that the railroads have again become interested in air cargo. First instance was in April, 1942, when the Gulf, Mobile & Ohio Railroad filed an application with the CAB for Rebel Air Freight, Inc., a wholly-owned subsidiary, to carry mail, passengers, and property over several routes in the Mississippi Valley and air cargo only between Chicago and New Orleans via East St. Louis and other points served by the railroad.

Second instance was in June, 1942, when the Transportation Association of America, a railroad dominated organization, filed a brief with the Federal Board of Investigation and Research urging future "integration" of all forms of transportation. This seemingly was aimed particularly at the air and motor carriers, urging their integration with the railroads. In some quarters this is held to be an expression of the inability of our railroad industry to reconcile itself to anything but a continuation of its virtual monopoly of transportation.

Then in the fall of 1942, the Illinois Central System issued a report urging the railroads of the country to weld themselves together to foster air transportation for the movement of high-grade merchandise traffic as a subsidiary to mass rail transportation, the idea being to superimpose air cargo operations on the present rail organizations.

The question, therefore, of who shall carry air freight is a problem confronting the CAB right now. It must be decided sooner or later. A hint of the board's probable attitude in passing upon applications for certificates of public convenience and necessity by carriers engaged in other forms of transportation is given in the American Export Airlines case decided in July, 1942, where approval of the control of American Export Airlines by American Export Lines, a marine company, was denied.

The Civil Aeronautics Act governs the acquisition of control of an air carrier by any other common carrier and stipulates that the CAB shall not approve such acquisition of control unless it finds that "the transaction proposed will promote the public interest by enabling such carrier other than an air carrier to use aircraft to public advantage in its operation and will not restrain competition."

Under the present construction of the provision of the Act just mentioned, the board has held that "no sound basis appears for distinguishing between an undertaking of a carrier engaged in another form of transportation through a subsidiary and its undertaking to engage in the air transportation field directly . . . it seems clear that Congress must have intended the same principle to apply to both situations because there is no sound basis for distinguishing between these situations so far as the public interest is concerned."

The board farther held that "in determining whether the public convenience and necessity require the granting of an application for a certificate by a carrier from another field of transportation . . . we would not construe the public convenience and necessity as requiring the issuance of a certificate to such carrier unless the evidence indicates the use of aircraft to be to public advantage in its operation and not restraining competition."

It is thought by some in the industry that this decision indicates the CAB will be careful to restrict air transportation to the airlines, but since the board has been known to reverse itself on important matters, others are not so hopeful that a definite policy has been stated.

It seems reasonable to expect, however, that the board will not permit the duplication of existing air transportation facilities with separate air cargo or freight systems. It would, for example, be just as logical to grant a certificate of convenience and necessity to one of the airlines to operate a railroad or a motor truck line between New York and San Francisco as to give a truck line, a railroad, or any other company, a certificate for an exclusive air cargo operation between those points.

Public convenience and necessity do not require such duplications. The present airlines cover the major portions of the country, and the feeder airlines



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when will be authorized in the future to carry mail, passengers, and cargo will completely blanket the remaining areas. There is, and will continue to be, competitive service between all large cities.

There seems to be no indication that the development of air cargo transportation by the airlines would take such volume from either the railroads or the motor truck lines that they should be entitled to go into the air cargo business in self-defense. The airlines will take some business, but it will be gradual, and it will probably be offset by the normal development of the country.

Much of the air cargo business will, however, be developed because the airlines will give a service impossible for the railroads or truck lines to render. Many marketing and merchandising methods will be changed by the possibilities of speedier transportation by air. The airlines will not haul coal, iron ore, lumber, live stock, cotton, cement, or many other products which account for the bulk of the railroad freight volume. There is an enormous local and short-haul tonnage for which the airlines could not compete with either the trucks or the railroads.

Air cargo should be handled by one coordinated organization owned by the airlines which are also handling mail and passengers. The reasons are:

1. Air cargo carriage is logically the domain of the present existing airlines or those authorized to operate in the future because of the economies of operating cargo flights under the same organization handling passengers and mail. By consolidating these operations, the overhead costs of maintenance and terminal facilities can be pared with passenger and mail operation, and for some of the smaller airlines which have been hampered in their operations by too little passenger traffic, the per-mile cost of operation can be reduced considerably.

2. In the inauguration of new routes such a combination would be particularly necessary—from the standpoint of passenger and mail operation as well as cargo. If the air cargo service were handled by a purely air cargo operator, new cargo routes would be delayed in their inauguration, as the development costs for air cargo alone would be too large. To expand all forms of air transportation into new territories—as quickly as they should be expanded after the close of the war—it will be necessary that cargo, mail, and passenger transportation be performed by the same air carrier.

Specialized air cargo carriers would probably ask for governmental aid in establishing new routes, but such aid should not be granted, since a similar grant to the regular airlines carrying passenger and mail would provide for those services at the same time. It has been proven in the development of other types of transportation that an uneven distribution of facilities is injurious to industry and commerce, and therefore it is the duty of the government to see that the growth of air cargo is rapid and complete enough to give all shippers and receivers an equal advantage.

3. Many small localities could be served much more efficiently from the standpoint of schedules of plane arrivals and departures if air cargo transportation were a function of the existing type of airlines. In some localities air cargo shipments would not justify more than one all-air-cargo flight per day, perhaps after five o'clock in the afternoon. If a company now transporting passengers and mail were offering the air cargo service, all shipments arriving during the day would have to remain at the terminal until the arrival of the night express flight. If the service were offered by the existing airlines carrying mail and passengers, shipments arising during the day could be placed on the passenger flights whenever space was available, thus providing better service.

4. One factor influencing arrangements which will be necessary for economic functioning of air cargo operations, is that the carrying capacity of any one plane is not elastic. For shipments which cannot be loaded onto one flight, another section of the flight must be added. Or if the volume of surplus shipments does not warrant another section, these shipments must be transported by later flights.

One effective way this factor can be reduced in importance is for the existing airlines to handle all cargo operations. If the cargo operations of these carriers are consolidated, every passenger and mail flight from a particular airport can carry whatever weight of cargo can be accommodated. Holdover of shipments from one flight to the next will not decrease the value of the cargo service from a speed-in transit standpoint, because air transportation is so much more rapid than ground transportation.

There is also the advantage that these surplus shipments can be routed over different airlines to the point of destination. If this is not done, any carrier offering only cargo service would have a tremendous problem on its hands in the efficient disposition of surplus shipments.

5. Airlines operating in areas like the Southwest will need low through rates for their shipments in order to enable shippers to sell in the Northeast in competition with manufacturers closer to the market. If the air cargo service is a regulated monopoly, there will be no question of two airlines serving different areas agreeing upon a joint rate before it can be put into effect. The airlines will be faced with a serious problem in the directional flow of traffic, and making rates so that they will develop a back haul traffic is a complicated problem which cannot be solved as quickly and as easily by making joint rates between two or more carriers as it can if only one organization is involved.

6. Competition in any industry such as transportation, which is subject to decreasing and joint costs, is likely to be cut-throat. The battle between two agencies carrying air cargo would be similar to the great railroad fights during the 1870's and 1880's and would be accompanied by a devastating loss of capital investments and poorer service. It has been clearly demonstrated that unrestricted competition in any form of transportation is against the national welfare.

7. However air cargo transportation may be organized, it will be necessary to provide a through service to any point in the country and to many abroad. This can be done much more efficiently if one company is responsible for making rates, routing shipments, preparing the bill of lading, the way bill, and adjusting claims for loss and damage. Lack of a unified service is a hindrance to the development of traffic. Shippers desire a service so organized that they can place a shipment in the hands of one agency with confidence that it will be routed in the most direct and economical way.

8. If air cargo were carried by one concern, owned by the airlines, there would be no need for the time-consuming and expensive governmental controls over the operation of new routes by one company as compared to another. Flexibility of new route operation is of paramount importance in any expanding transportation service, as both the company offering the service and the shippers would need the most complete service that could be offered. Prudent business policy would make for a careful study of traffic potential of any new route, also for an immediate abandonment of the route in case the traffic was not as large as expected.

9. If the air cargo industry were divided among rival companies, the necessary advertising and solicitation required might easily degenerate into an intra-industry battle rather than having all efforts directed toward obtaining new traffic. Weakening of sales promotional work by such intra-industry competition would not be in the best interests of air cargo or the shippers.

10. Properly to promote the use of air cargo services, the organization must be owned and controlled by persons interested in seeing it develop to its maximum extent. The leadership must be keenly alive to the potentialities of air transportation and must believe in the economies present in the utilization of air by shippers. Other carriers are imbued with the problems and methods of a ground transportation system and so would be unfit to promote air cargo. The leadership must be inherently airminded.

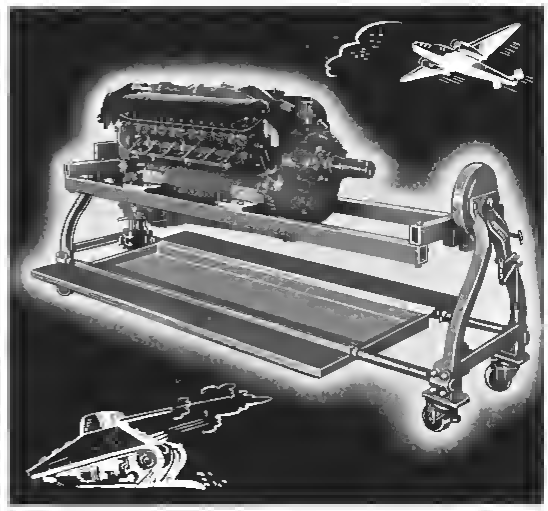
11. The promotional effort of the existing airlines has developed air cargo (with some assistance in the last year or so from Railway Express Agency) so that it can be made a profitable business. It is only by the efforts of these pioneers that the industry has reached its present state of maturity. They should reap the benefits—not other carriers or "outsiders" who were unwilling to invest their money when the prospects for profits were not so evident.

Visual Aids

(*Continued from page 269*)

separate subjects, and a total of 480 individual pictures.

Basic Aircraft Metal Skills Kit. Eleven subjects.



Designed to Speed Up Production, Rebuild and Tear-Down Engines

★ Designed especially for use in the building, tearing down and rebuilding of Allison engines, this engine stand is gear driven, with provisions for locking at predetermined angles. All special tools required for this engine clear the mounting fixtures. Equipped with floor stops for holding stand rigid when not on assembly line. Literature on this stand, and on our complete line of stands for all types and makes of aeroplane engines will be sent on request.

Staley MANUFACTURING CORPORATION

COLUMBUS, INDIANA, U. S. A.

Oxyacetylene Welding Kit. Total of 15 subjects, 800 individual pictures.

In addition, there are supplementary slidefilm kit-sets covering such subjects as basic electricity, machining, etc.

Perhaps one of the best examples illustrating these visualizations via the use of such films is found at the Casey Jones School of Aeronautics, Newark, N. J., which trains aviation mechanics for both the Air Forces and Civil Service in an intensive 15-weeks' course. An affiliate, the Academy of Aeronautics in New York City, uses the same system of instruction.

Combining practical work-bench experience with theory and classroom study, classes are conducted by practical specialists in every branch of aircraft repair and maintenance, including engine, sheet metal work, propellers, hydraulics, welding, instruments and electricity. The school has the very latest shop equipment, making it possible for the student to actually execute many or most of the points and principles in plane servicing covered in both lectures, text-book study, and on the picture screen. Visual aids consist of the slidefilm kit sets and form the preliminary basis of the course. Beginners also are given instruction in mathematics, draftsmanship, and other sciences as they are applied or involved in aviation.

Films used in this school are, however, supplementary. For instance, let us take a welding class in order to follow the process of their utility through to the use of the torch.

First stage for the newcomer in a welding class, for example, is to view the first of the subjects in the welding kit—"An Introduction To Welding". This is done in class, in or near the welding shop where equipment is ready for instant use. To make this possible under such conditions, Thomas Schlitz, visual aid director, has designed a special shadow box screen for projecting the pictures. This makes them easier to define in a room fairly well flooded with daylight, permitting students to make notes.

As the film is projected, the instructor reads the letterings or notations, or elaborates and discusses what is shown. The film may be stopped and held for questions. When the film has been completed, there is usually a question and answer period, or a general discussion by students.

Same process is followed for each subject, except for points adaptable to actual execution in the workshop (and in welding nearly all of them are demonstrable) when the class is taken to the equipment.

Printed text books parallel the film subject matter. After every lesson—the basis for each being the film—students fill out examination papers for subsequent grading by the instructors.

One outstanding advantage of the visual method is that a lagging student may individually re-project the film in order to freshen his memory. Other advantages: The instructor can control the "pace" of the study, gaging it to the capacity of his class; pictures are large and illuminated, and compel concentration; complex points become more easily understandable when pictured; the slidefilm method tends to discourage digression, and each student gets the same understanding of an idea or fact.

It is the belief of those in charge of instruction at the Casey Jones School that this method has proved its ability to save valuable time in the preliminary stages of instruction, saving especially in eliminating the need for extensive verbal explanations of fundamentals which are more quickly grasped from pictures.

Plywood Structures

(*Continued from page* 153)

For the plating at the neutral axis this becomes, with an assumed shear of 2,000 lb.—

$$Q = 2 \times 28.2 = 56.4$$
$$b = 2 \times .125 = .25$$
$$I = 1{,}504$$
$$f = \frac{2{,}000 \times 56.4}{25 \times 1{,}504} = 300 \text{ psi.}$$

Determination of the allowable shear load on the panel requires examination of the grain direction of the shell panel. Normal construction would involve the grain arrangement of Fig. 4, and the original premise of compression in the upper fibers would call for the shears as indicated in this figure. Because of the size of this panel, it may be assumed that the compression veneers will buckle out of action and all of the shear will then be carried by the diagonal tension fibers.

Whence,

$$F_{diag} = S_{panel}/t_c h \sin 45 \cos 45$$

where t_c = Tension grain thickness

$$S_{panel} = \frac{f\,th}{t_c h \times .5} = f \times 2 \times \frac{t}{t_c}$$

for 3 ply construction $t/t_c = \frac{3}{1}$

Whence,

$$F_{diag} = 3 \times 2 \times f_c = 6 \times 300 = 1{,}500 \text{ psi}$$

This diagonal tension stress will have, as an allowable, the tension allowable of the wood fibers. Thus if the veneer in question is spruce, an allowable tension of 10,000 psi might be used. In actual practice it is well to reduce this allowable by approximately 25 percent in order to allow for imperfections in the wood and to provide for possible strength reductions due to the panel deformations causing stress concentrations near the panel corners. The margin of safety of the shear panel on this basis will be—

$$M.S. = \frac{7500}{1800} - 1 = 3.16$$

Suggested Method of Obtaining Accurate Moduli of Rupture

It is realized that the above discussion has added little data upon which strength conclusions can be based. The actual structural design of any aircraft carried through to justifiable margins of safety is inextricably involved with the static tests of the article itself. This is necessarily so, since each aircraft is designed for definite service requirements and has individualized openings, force paths, and discontinuities. The complete and authoritative check of the structural integrity must, therefore, be based on the structural test of the part itself. This procedure is admittedly expensive, but careful analysis of the reasons underlying the current cost of static test work lead to definite steps whereby these costs may be reduced.

Certain cost factors, such as special test jigs, setting up for test, and handling of test equipment are controllable only by intelligent efficiency of test crews. Other factors are the length of time required to complete static tests and to minimize repetition of tests. With proper time arrangement of subassembly and parts tests, it is practicable to reduce the final test on a complete structure to the status of a routine check and a record of the actual strength incorporated in the structure.

Inclusion along with the subassemblies tests of specimens duplicating structural sections of the airplane will lead to quite rational and directly applicable structural data which can then be incorporated in the complete static test article with a minimum of cost. The value of such preliminary structural tests becomes apparent when final tests on the complete article are run, and is evidenced by the speed with which the final tests may be completed.

Experience with this method of obtaining allowable stress information has indicated the advisability of daphcating, so far as possible, the proposed section and the correct ratios of moments, shears, and local loads during the substructural tests. Monocoque structures are often seriously redundant as to load force paths and minor loads, such as locally applied shot bags or pressure pads. These loads may reduce the strength of structural members by an unforeseen amount. The number of such tests need not be excessive, since the flow of material between even, widely-spaced sections will have some uniformity, and it may then be anticipated that any variation of allowable

stresses will have a similar uniformity. Furthermore, tests of sections within the range of minimum sizes would be superfluous, thus further confining the area on a given part for which tests are advisable.

The inevitable question will arise as to why a stress analysis other than load determination is necessary, since complete tests are being run. Certainly a great many man hours are spent in preparing stress data, and since the answers obtained are so often overruled by test, the analysis loses much of its former significance. The real and useful function of a careful analysis is two-fold. It provides the basis for a uniform flow of material varied in proportion to the load requirements and hence a uniform structural strength throughout the aircraft. This is essential if good control is to be exercised over structural weight.

The analysis performs the additional function of indicating the desirable sections for preliminary tests and indicates the use to be made of the preliminary data. This latter point is of importance, since it frees the individual section tests of the necessity of making good any predicted load. An understrength section of a wing, for example, is then merely moved outboard to a location where its actual strength is adequate to carry the loads. Cost of such change is confined to the engineering department and drafting room and involves no expensive jig or tool changes.

Perspective Projection

(*Continued from page* 125)

allel to this perpendicular line-set (horizontal and parallel to *PP*) will themselves be horizontal. This is indicated in Fig. 5 by line *AD*, for example. At appropriate places, these tabulated locations will be confirmed by the theory.

When the x-z plane of the object is *not* in *PP*, but behind it and parallel to it, as in Fig. 6, Method 1 will be found better than Method 2. The construction for this method is clearly shown in the figure. If Method 2 is used, the location of the *VP* indicated is given in Table 1 as being in *HL* and *V*. This is the same location as that in Fig. 5, where the front of the object was in *PP*. Principle 1 is now applied in the manner indicated by the following example, in which the perspective of point *D* is determined.

The perspective of the horizontal line containing *DC* is drawn from *M* in *PP* to *VP*. (To obtain the elevation of *M*, the end view shown must be used.) The perspective of another line through *D*, say the vertical one, is now found

TABLE 1. LOCATION OF VP

Type of Line-set	Location of *VP*	
	Set not parallel to *PP*	Set parallel to *PP*
I. Horizontal	In *HL*	
1. Perpendicular to *PP*	to *V*	
2. Not perpendicular to *PP*	Not in *V*	In *HL*, an infinite distance to right or left. Perspective will be horizontal
II. Non-horizontal	Not in *HL*	
1. In *V* (or planes parallel to *V*) (a) Up and back from *PP* (b) Down and back from *PP*	to *V* Above *HL* Below *HL*	Not in *HL*, an infinite distance above or below *HL*. Perspective projection will be vertical
2. Not in *V* (or planes parallel to *V*)	Not in *V*	Not in *HL*, an infinite distance away. Perspective projection will be parallel to the line in space

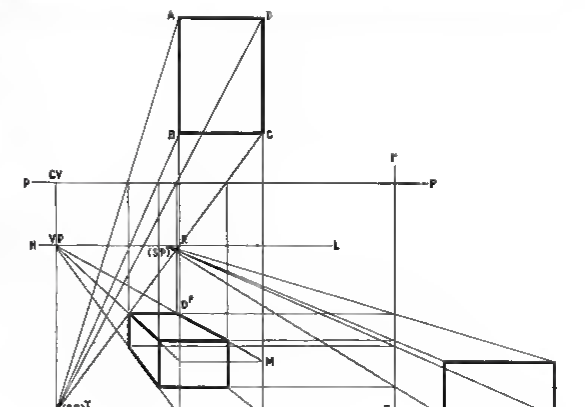


Fig. 6. One-point perspective by Methods 1 and 2 (front of object behind *PP*)

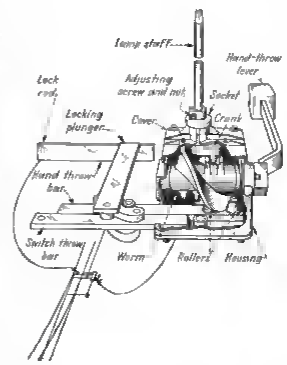


Fig. 7. Common one-point perspective of railway operating switch mechanism

by dropping a vertical projection line down from the top view of the point where the sight line (from $(SP)'$ to D) pierces *PP*. The intersection of these two perspectives gives D'.

Fig. 7 is an actual manufacturer's pictorial drawing in one-point perspective of a railway switch operating mechanism. A broken-out section, in conjunction with various types of shading, supplements very well the clarity of this pictorial drawing.

How to Fair Lines

(*Continued from page* 140)

fairing step, therefore the curve should have a desirable shape, even at the expense of missing the plotted points. A general reversal of plotted points indicates an unfair original curve.

In terms of calculus, the slope of a curve at any point is equal to the first derivative value of the curve at that point, so the above curve is called the

first derivative curve. This first derivative, or slope, curve is symbolized by dy/dx, or dx/dy, the symbols denoting the direction of axis.

The curve just explained is the dy/dx curve, i.e., the slopes are measured to the horizontal axis. For many curves the dy/dx values will range from zero to infinity, and the larger values are impractical to plot. An explanation of the method of handling these extreme values of slope will be given later in this treatment.

Slopes are read from the original curve by using a special type protractor which reads the slope directly in terms of the tangent (dy/dx). The use of the protractor is shown in Fig. 8. There is an example of the first derivative curve shown in the illustration, Fig. 6B.

Third Step—Integration of the First Derivative Curve. In this operation, the correct fairad offsets for the original curve are obtained. The offsets are found by mechanically integrating the first derivative curve of our second step.

Integration of first derivative curve is, in effect, a determination of the area contained between the derivative curve and its base axis, and it is accomplished by summing up trapezoidal areas. (Note: the trapezoidal rule is *not* employed.)

Straight lines are assumed for sections of the curve, and the trapezoidal areas, contained between the straight line and the base axis, are determined. The trapezoidal areas are shown in Fig. 6B.

The straight lines are assumed by eye, as shown in Fig. 7. Note the areas enclosed by the curve and the straight line. The sum of the two areas on one side of the straight line, must be equal to the area on the other side of the straight line. For simplicity, the extremities of the straight line should be chosen as even-dimensioned base axis stations.

The average ordinate of the straight line is equal to the average ordinate of the curve, and, therefore, the area under the curve is equal to the average ordinate of the straight line multiplied by the base axis station span. (See Fig. 7). Observe that the trapezoidal area represents a difference in offsets of the original curve extremity stations, as shown in Fig. 6.

Correct offsets for original curve stations are obtained by adding the trapezoidal areas—progressively and algebraically—to a chosen starting offset of the original curve. The starting offset can be chosen as the leading edge point, the trailing edge point, an offset to be held, or some other convenient offset of the original curve. Sometimes it is convenient to choose a starting offset in the middle of the original curve and then determine offsets fore and aft from that middle station.

The area under the first derivative curve determines the corrected original curve offsets, therefore the first derivative curve must be such that the area underneath it will produce the offsets that are desired at certain stations.

For example, in Fig. 4 both ends of the plan view curve must have offsets equal to zero. In case the resulting offsets are not what is specified for certain points, the first derivative curve must be adjusted, that is raised or lowered to change the areas and produce the proper offset. Prediction of the necessary change in the derivative curve will usually make one curve adjustment sufficient.

The derivative curve should not be adjusted into an unfair curve. Unfairness of the first derivative curve indicates not only unfairness in the original curve but also unfairness in the second derivative curve.

Small adjustments of the derivative curve can be effected by changing only the original curve offsets. In such cases the total original curve offset change desired is spread evenly over several stations. However, such original curve offset must be affected somewhat less than the accuracy tolerance allowed. If such small changes were to be made on the derivative curve, they would be hardly discernible.

Judgment and experience are the best guides for making derivative curve adjustments.

It is desirable to make a table of the trapezoidal areas, resulting original curve offsets, etc., as is illustrated below. This table can be made on the graph sheet, or on a separate piece of paper which should be subsequently attached to the graph.

Sta.	Offset	Av. Ord.	Span	Trap. Area	Slope
10	2.079				185
		.188	1	.188	
11	2.842				162
		102	1	102	
12	2.944				072
		Etc.			

We now have our line faired and have offsets determined for certain integer stations. Many structure stations, however, will be on non-integer dimensions, so in Part II of this article (March AVIATION) we will analyze the method of determining offsets for such stations.

Miracle of 1942

(*Continued from page 223*)

Already touched upon, the system of subcontracting and licensing, especially the great role of the automotive industry, was significant in the whirl-wind developments of '42. The Detroit division alone produced the "makings" of 750 heavy bombers, 1,500 medium bombers, and 4,500 fighters.

Regardless of this broad dispersal of most complex production from the mother factories to licensees and subcontractors, tolerances of the products have been so carefully adhered to that the parts made by half a dozen different plants can be jumbled and reassembled into perfect finished units. On more than one occasion during the year they were thus jumbled and reassembled to prove the point.

So much for the salient facts, but the complete story of 1942 still awaits revelation of that considerable progress which is still banned from discussion by war secrecy. Even so, specific achievements of certain companies in the first year of conflict can be briefed.

CONSOLIDATED-VULTEE: Current production three times the rate prior to Pearl Harbor . . . *Liberator* production mechanized on moving assembly lines, doubling production in six months with but 10 percent more workers . . . Reduction in prices in government *Liberator* contracts by more than $100,000,000 via new efficiences . . . Aluminum substitute, efficient in many parts of planes, developed by Vultee engineers working with a type of thin sheet steel called "expanded metal."

UNITED AIRCRAFT: Pratt & Whitney engines and Hamilton propellers both running ahead of schedule . . . Ford, Buick, Chevrolet, Nash-Kelvinator, and Jacobs rolling out P&W's under license, with Continental to be shortly underway . . . Extension of P&W's own plant facilities through three New England satellite plants, with entire departments taken over without loss of an hour's production . . . Two more such satellite plants about to open.

CURTISS-WRIGHT: Besides great advances in P-40's, developed *Commando* and *Caravan* transports for Air Transport Command and allied services . . . Devised aluminum alloy forged cylinder head for added plane power . . . Perfected plastic push rod housings and baffles.

BELL: Made gross deliveries valued at approximately $120,000,000, as compared with approximately $5,000,000 in 1940—an increase of well over 2,000 percent . . . Adopted methods of mechanical handling of parts and materials, typified by successful use of constant-motion production lines, which aided in boosting output of P-39 *Aircobras* . . . Since Pearl Harbor has recruited an army of women workers, now comprising more than 40 percent of its production personnel.

MARTIN: Very large increases in production of B-26's for the Army, PBM's for the Navy, and type 187 *Baltimores* for the British, all new designs requiring "from the ground up" production planning . . . Emergence of B-26 as a torpedo bomber . . . Company doubled its personnel.

BOEING: Increased rate of production of *Flying Fortresses* by approximately four times since Pearl Harbor . . . Maintained peak production without interruption as transition was made from B-17E to B-17F, despite necessity of 400 separate changes. First "F" was delivered on same day as last "E" . . . Significant advances made in special high-altitude research.

ALLISON: Raised horsepower of basic engine model 15 percent (increase in sea level rating for use with turbo-supercharger at altitude) and increased altitude rating 25 percent (increase in critical altitude rating, horsepower remaining same) with overall size of powerplant retained and weight increased only 2 percent . . . Production of engines and parts up 58 percent during year . . . Improvement of manufacturing efficiencies of 38 percent, with scrap losses reduced at least 50 percent.

FAIRCHILD: Plant facilities of all divisions more than tripled . . . Production of *Ranger*-powered PT-19 trainers up more than 120 percent . . . Production of both six- and twelve-cylinder *Rangers* increased almost three times . . . Developed AT-15 and AT-14, crew training craft made by Duramold process.

NORTHROP: Raised dollar volume of production from $6,000,000 to approximately $62,000,000.

NORTH AMERICAN: Increased personnel to 40,000, expects to have 100,000 workers in '43.

RYAN: Developed PT-25, new plywood military craft . . . Advanced its "flow production" methods for manufacture of aircraft engine exhaust systems.

BELLANCA: With but 30 percent "up" in manufacturing facilities, increased production of units for Martin planes 2½ times . . . Meanwhile, doubled floor area for manufacturing AT-15 trainers.

FLEETWINGS: Achieved new production high in making plane surfaces via mobile-assembly system utilizing more than a dozen straight-flow lines.

JACOBS: More than doubled manufacture of Jacobs engines . . . Put new plant into operation making P&W engines.

PIPER: Designed and built TG-8 training glider . . . Developed J5-C *Super Cruiser* single-litter ambulance plane . . . Raised production on L-4B standard trainer.

TAYLORCRAFT: Converted two-place trainer into TG-6, three-place training glider, and completed contract in November . . . Introduced porcelain enameling of airplane engine exhaust and muffler systems . . . Developed, with Forest Products Laboratory and Radio Corporation of America, multi-laminar wood spars for wings used in its TG-6 gliders and L-2B liaison planes.

FORD: Completed, on schedule, first contract for several thousand P&W engines . . . Developments to speed production included use of water-cooled arbor keeping cylinder barrels cool inside and out while grinding, and application of liquid air principles in insertion of main crankshaft bearing in power section . . . First B-24's began coming from line at huge new Willow Run aircraft plant.

GENERAL MOTORS: More than half of war production of 104 plants (including Allison) for air forces of United Nations.

. . . Not the whole story, to be sure—but a significant sketch of causes with the Axis getting the effects!

Drop Hammers

(*Continued from page 149*)

venting the punch from pressing the metal solidly into the bottom of the die.

Through the use of a marking gage, the cutting bit can be adjusted to the gage of the metal to be used and grooves cut on the vertical sides of the punch. Then by removing enough metal to remove the grooves the desired clearance is obtained. Scrapers made from old files can be used for this work.

While the general procedure described for lead punches is also applicable to small zinc alloy punches, an entirely different method must be used in making large Kirksite punches. Shrinkage toward the center of the molten mass is apt to leave an excessive amount of space between the male and female die, a condition which even excessive pounding cannot aid in assuming the desired contour, as can be done with lead. For large zinc alloy dies, a pattern must be made for the punch instead of the female die, and a punch cast in sand. A form is then fastened around the punch for pouring the female in much the same manner that a lead punch is cast over a female die. Shrinkage towards the center of the mass will result in an exceedingly tight fit between the punch and the die. The punch should be preheated before pouring the female as is done with the ordinary zinc die when lead is poured into it. A solution of whiting and silica flour (half and half) thinned out with water to which is added 4 oz. of molasses per gallon of solution is then sprayed onto the punch before pouring. This will prevent the male and female from shrinking together so tightly that they cannot be separated, and spraying to the proper thickness permits allowance to be made for the thickness of the sheet that is to be formed in the die, thus eliminating extensive die fitting work.

There has been considerable question lately as to the value of the drop hammer in aircraft production. A great many newcomers to the industry—particularly those from the automotive field—have looked upon it with disdain, and we also understand that on the West Coast many of the larger plants are removing, rather than installing, drop hammers at this stage of the game. The authors do not for one moment consider the drop hammer to be the cure all of any production problem involving sheet metal. Quite to the contrary—it has a definitely limited sphere of efficient utilization. Beyond these limits, it is unsatisfactory, but within its confines no other method can compete with it satisfactorily. Assuming that the quality of material is one generally used in aircraft work, we have two factors that must be considered—first, the depth of the draw, second, the number of parts that must be run. The question as to how deep a draw is feasible on a drop hammer has been thoroughly covered (AVIATION, Nov. 1942, Range of Drop Hammer Operations).

Where we have a part that can be satisfactorily worked on a drop hammer, or perhaps we might say a drop hammer part, and the run is not more than several thousand—and even where the run is in the upper brackets of thousands—where the possibility of a change in dimensions of the part exists, the drop hammer is still the logical method of manufacture. Each engineering order that changes the dimensions of a part, from a production standpoint may generally be considered the end of one part and the beginning of another. The drop hammer can be employed chiefly for low production where the amount of money involved for the cost of steel dies is too much, and there are yet too many parts to be formed by hand.

Until recently there were very few parts used in sufficient quantity in an airplane which would make feasible the use of steel dies. In the automotive industry a model is frozen and produced in units sometimes reaching 1,000,000 in a given year. Who ever heard of an aircraft model being frozen for that length of time? It is not infrequent in aircraft production for designs to be changed even before manufacturing has begun.

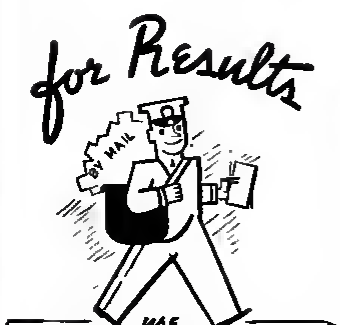
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